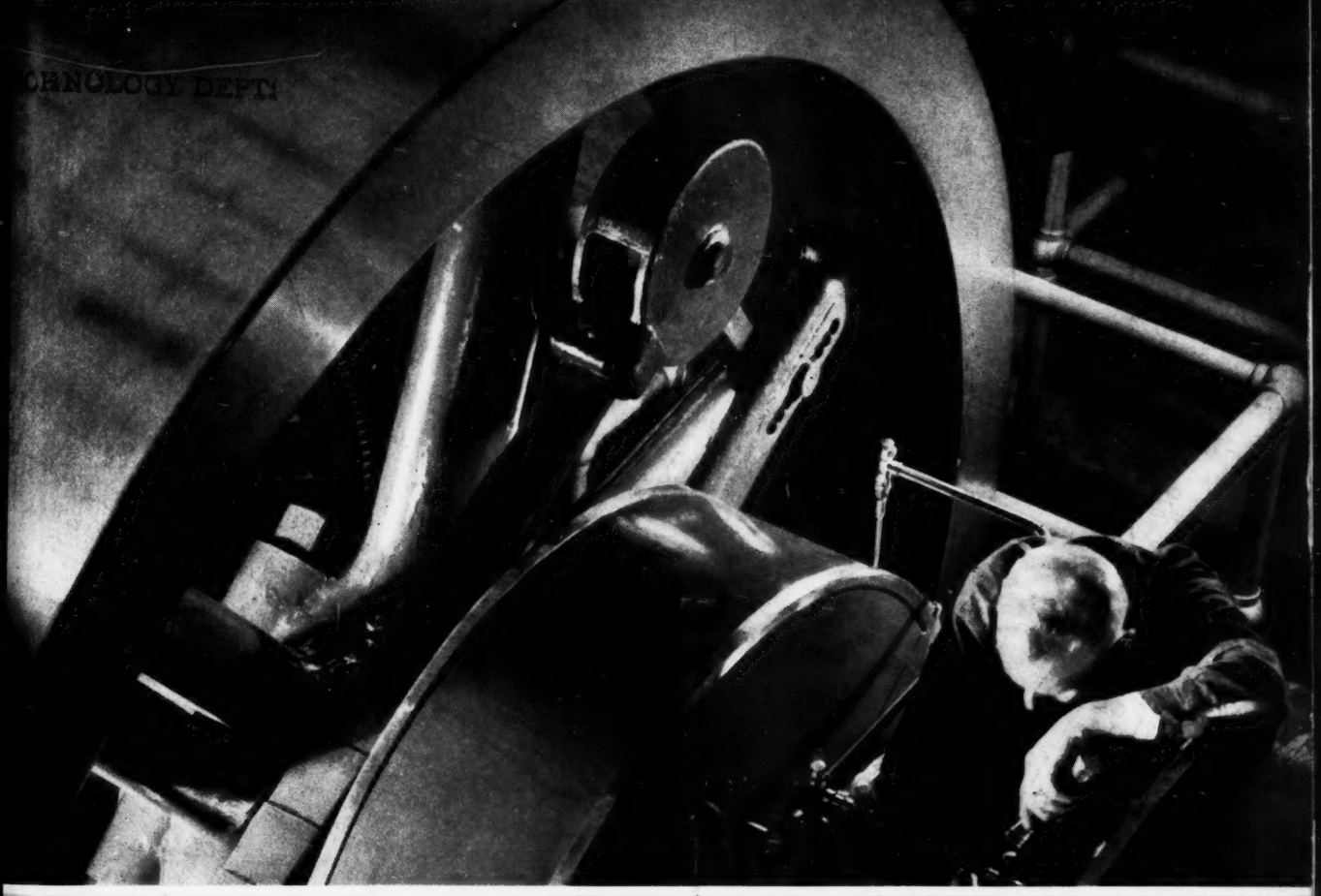
POWER PLANT ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

CHNOLOGY DEPT



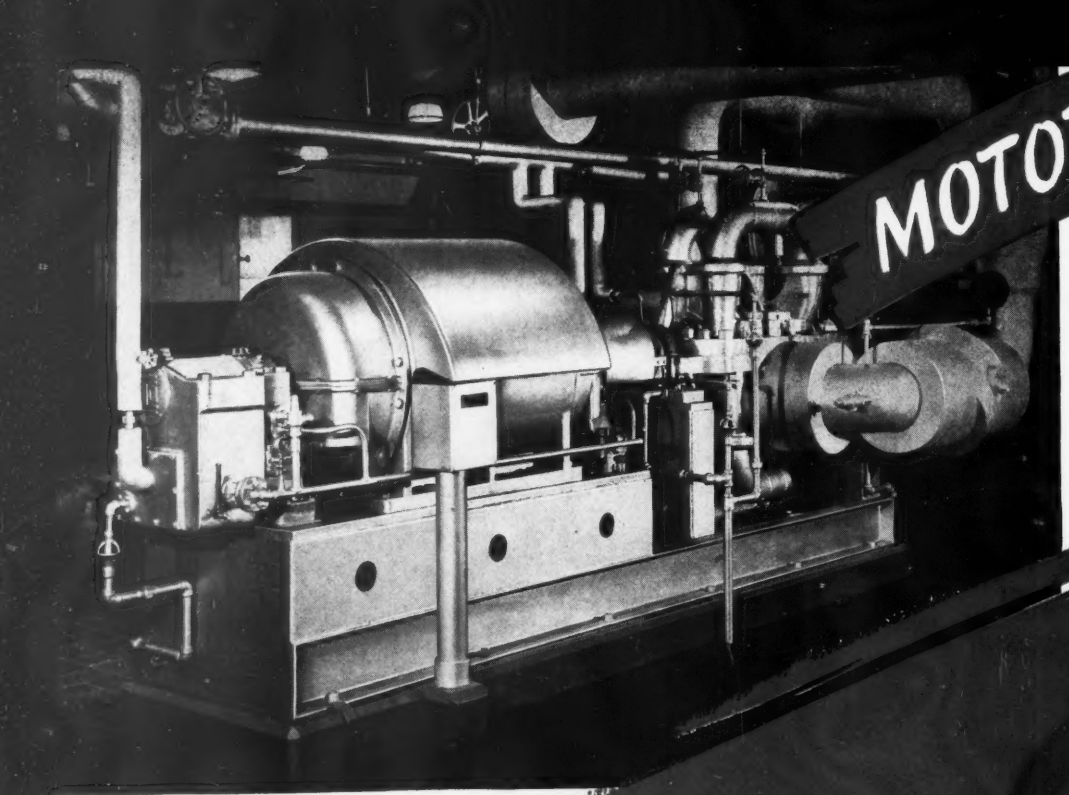
DEW POINTS OF FLUE GAS

Extension to Cape Fear Station • **Protective Lighting in Industry**

Wartime Boiler Plant Design • **Maintenance of Recording Instruments**

Other Articles Listed on Page 45 • *Current Circulation 20,600*

JANUARY
1943



MOTORS

When your conditions call for mo
drives for boiler-feed pumps a d oth entilatir
auxiliaries, investigate wha Elli bility.
Company has to offer. Large hig Diamon
speed, two-pole induction mo ors, i o give h
the one shown in the picture a the ase of s
are an Elliott specialty, resulting fr ng and
25 years of study, experiment, and Elliott
search in Elliott shops. We are build nge
many of these motors, in all sizes, o spe
utility plants. They call them exce
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The drive to fit

is built by

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Compa
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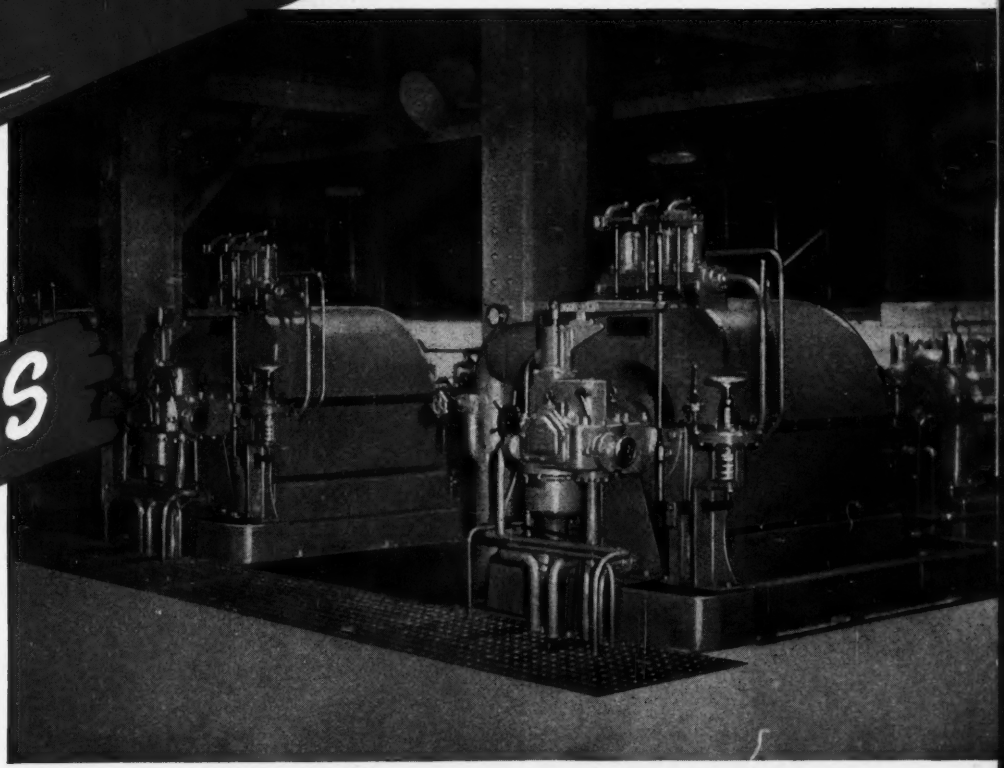
entilating features which add to reli-
bility. Often the Elliott patented
Diamond Cage" construction is used
give high starting torque and, in the
ase of synchronous motors, high pull-
ng and pull-in torque.

Elliott Company makes all types
arge motors, and designs motors
or special applications.

your heat balance

TURBINES



When the heat balance calls for steam drive, or variable speed is important, Elliott turbines fit the picture. Elliott Company's line of mechanical drive turbines covers the complete range of sizes required by power plant auxiliaries; steam conditions up to 600 lb. gage and 750 deg. F.; gears, built-in or separate, when required; from small single-stage turbines up to large multi-stage, high-efficiency turbines, such as those illustrated at the right.

Elliott engineers know how to fit the turbine to your needs and conditions, and how to attain both high efficiency and maximum dependability. Ruggedness is a characteristic of Elliott turbines, both multi-stage and single-stage.

We also build all-Elliott turbine-generator units from small sizes to around 10,000 kw.

Should the type of drive be in doubt, we'll be glad to lend our experienced advice. Details on Elliott motors and turbines are available for the asking.

Q-1069

ELLIOTT COMPANY

JEANNETTE, PA.
RIDGWAY, PA.
SPRINGFIELD, OHIO

DISTRICT OFFICES IN PRINCIPAL CITIES

Iron Fireman Cuts Steam Costs

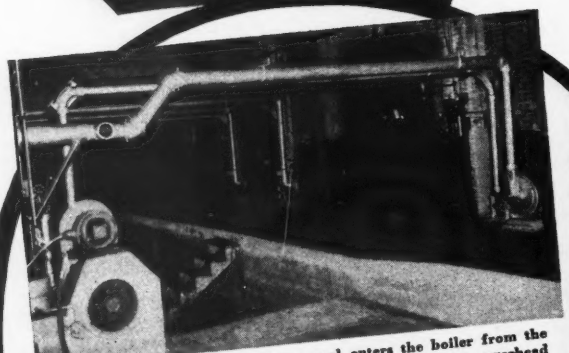
Fuel Cost Savings

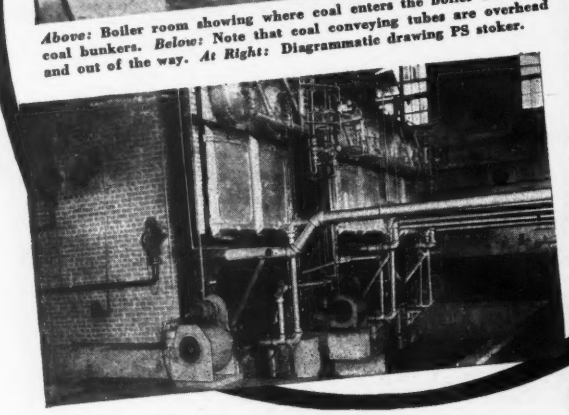
Marshall C. Stone, vice president and general manager, Pacolet Manufacturing Company.

THE Pacolet Manufacturing Company has cut steam costs from $0.349 to $0.237 per thousand pounds by the installation of Iron Fireman pneumatic spreader stokers. This reduction of 32% in steam costs amounts to fuel savings of $14,784 a year, according to Marshall C. Stone, vice president and general manager, who adds: "The investment will be self-liquidating in a short time."

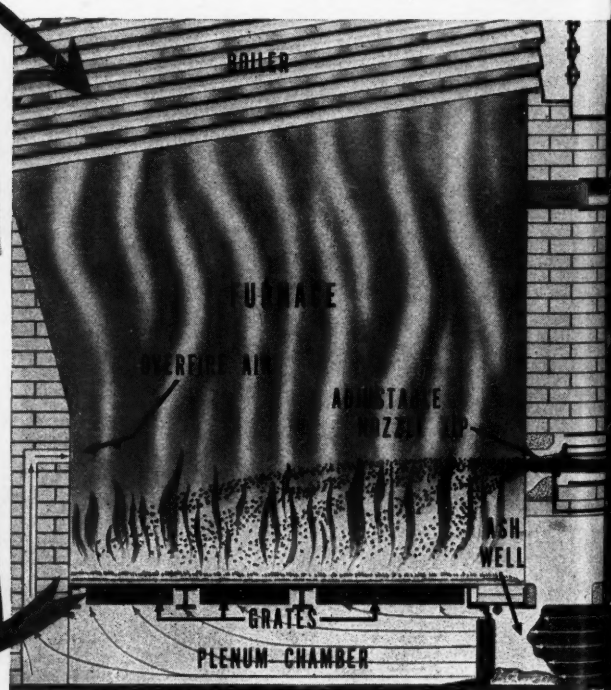
Facts speak louder than claims. Iron Fireman makes no premature claims as to what it can do for you, but Iron Fireman equipment has made such outstanding achievements in so many industrial plants that we do urge you to ask us for a survey and recommendation. Each boiler room has peculiarities of its own, of course, but the Pacolet job is in many ways a remarkable example of modernization.

There are three B & W Vertical Baffled boilers rated at 266 h.p. at 145 pounds pressure. These boilers are 38 and 40 years old. One boiler had been out of commission for 15 years. The boilers are now operating at 77.5% efficiency with a processing load. Two boilers



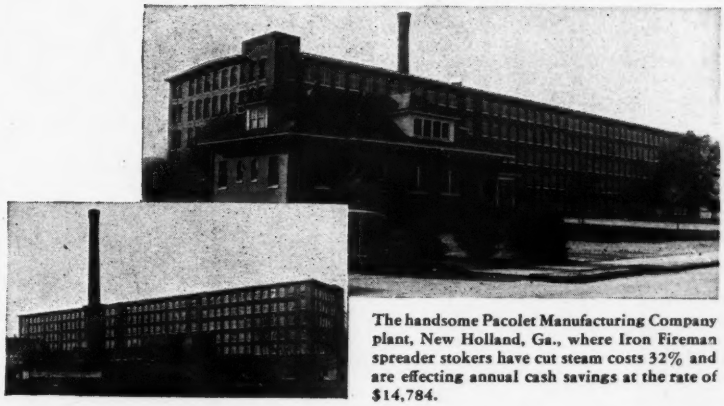


Above: Boiler room showing where coal enters the boiler from the coal bunkers. *Below:* Note that coal conveying tubes are overhead and out of the way. *At Right:* Diagrammatic drawing PS stoker.



32% at Pacolet Mills

$14,784 a Year



The handsome Pacolet Manufacturing Company plant, New Holland, Ga., where Iron Fireman spreader stokers have cut steam costs 32% and are effecting annual cash savings at the rate of $14,784.

operate at 110% of rating with a processing load in summer, and in winter with a heating load in addition to the processing load, they operate at 165% of rating.

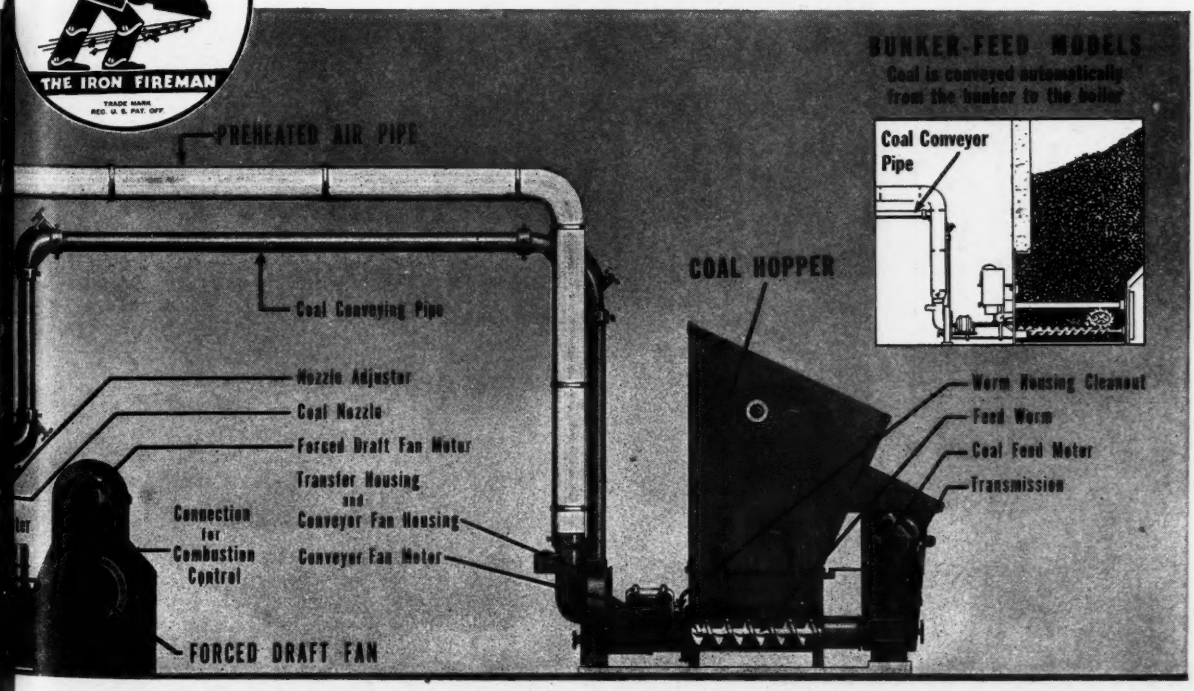
In addition to the fuel saving, considerable labor cost has been eliminated in the handling of coal, because the coal is fed directly from the coal bunker outside the boiler room.

The diagrammatic drawing shown below illustrates clearly how the Iron Fireman PS stokers function. The pictures at the left are actual views of the Pacolet Manufacturing Company boiler room.

We ask that you, in the interest of fuel conservation and increased plant efficiency, as well as your own profits, give Iron Fireman an opportunity to show what can be done for you. Iron Fireman Manufacturing Co., Cleveland, Ohio; Portland, Oregon; Toronto, Canada. Write or wire 3323 W. 106th Street, Cleveland, Ohio.

IRON FIREMAN

Automatic Coal Stokers



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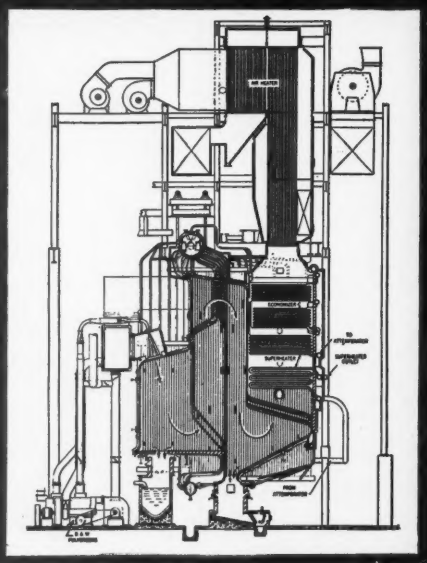
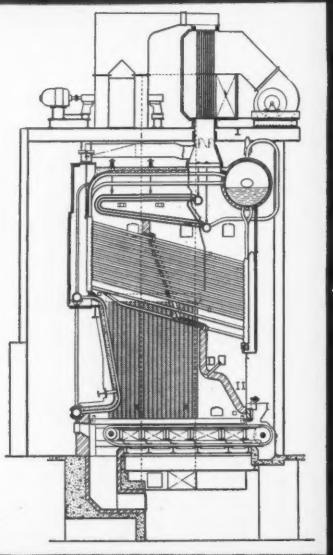
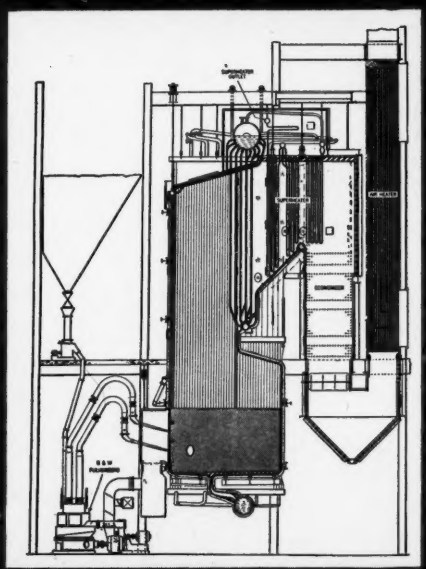
B&W

STEAM-GENERATING U



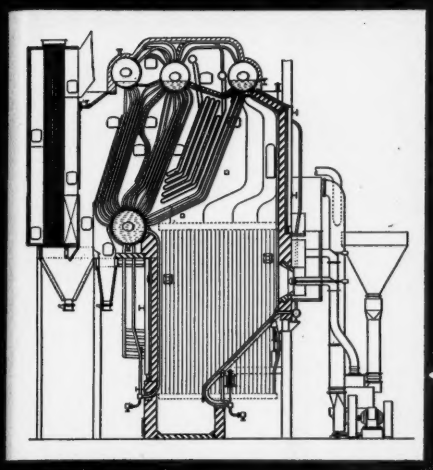


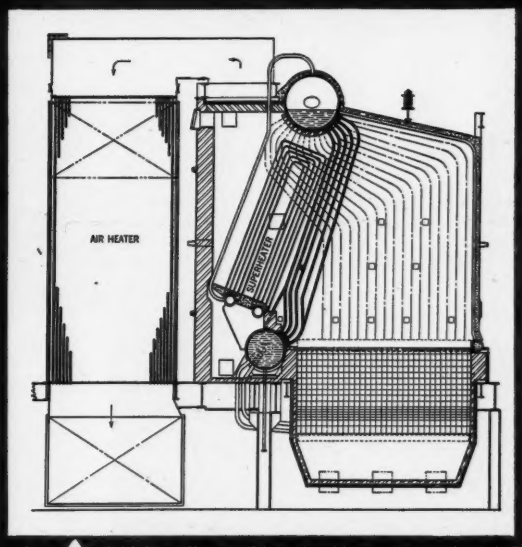


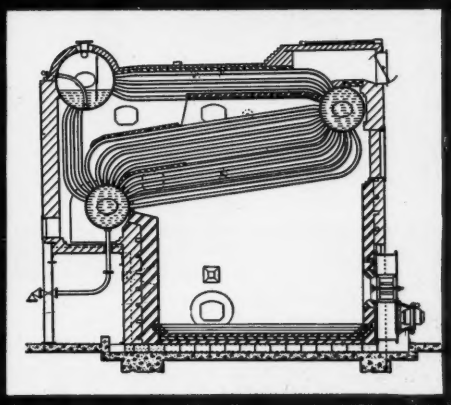
B A B C O C K &U

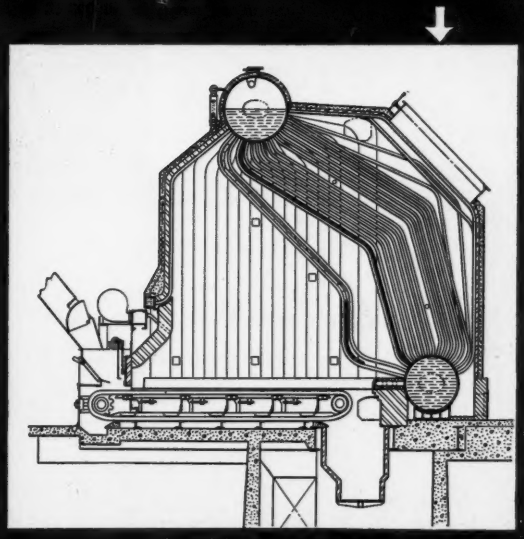
THE BABCOCK & WILCOX COMPAN

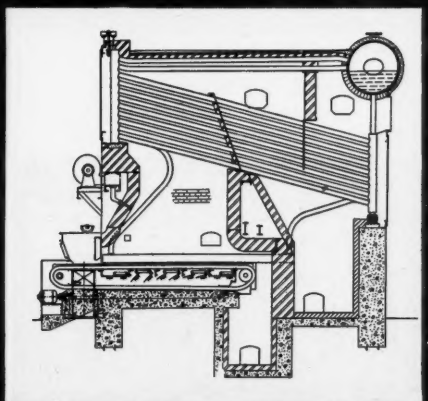
G UNITS HELP POWER THE WAR EFFORT..











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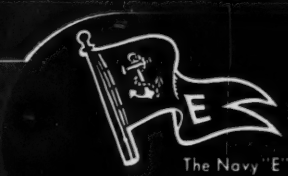
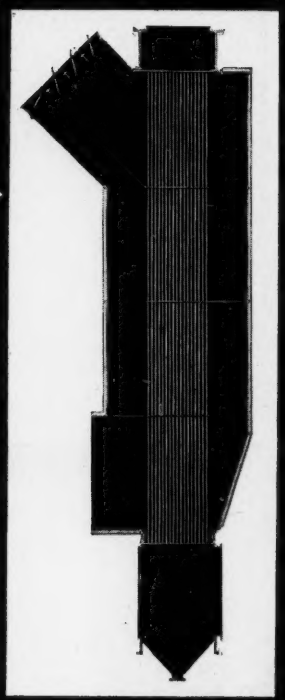
& WILCOX

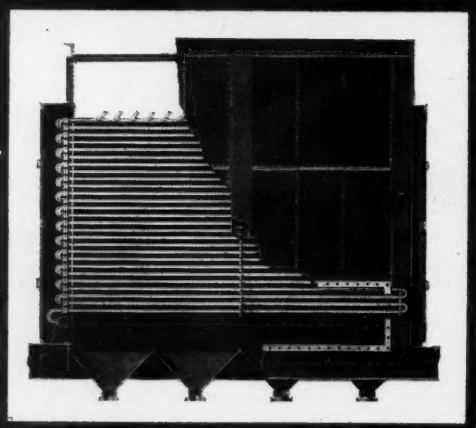
STREET, NEW YORK, N.Y.

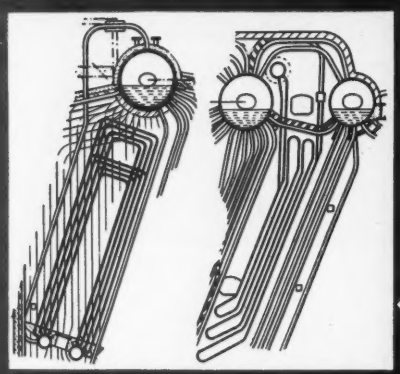


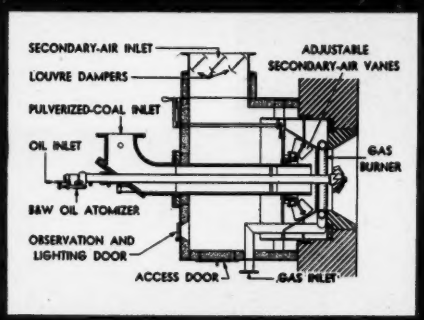
The Navy "E" Award to the Barberton Works for production achievement is "an honor not lightly bestowed and one to be cherished."

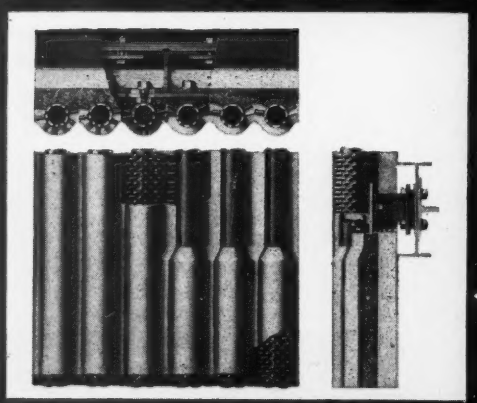
B&W EQUIPMENT PROVIDES AS







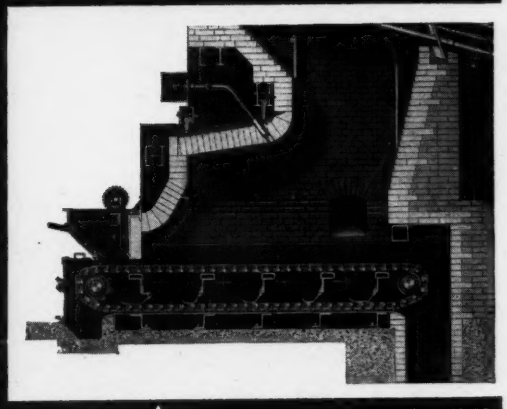


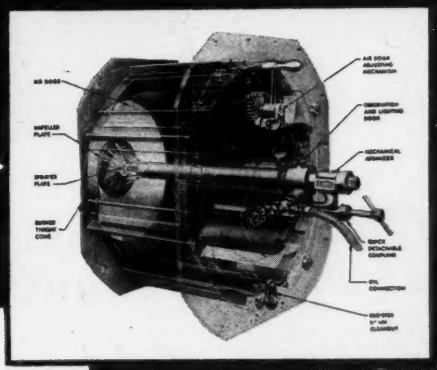


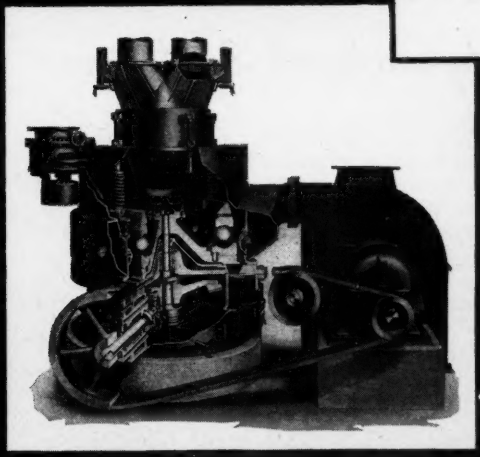
BABCOCK &U

THE BABCOCK & WILCOX COMPANY

ES ASSURANCE OF MAXIMUM PERFORMANCE . .







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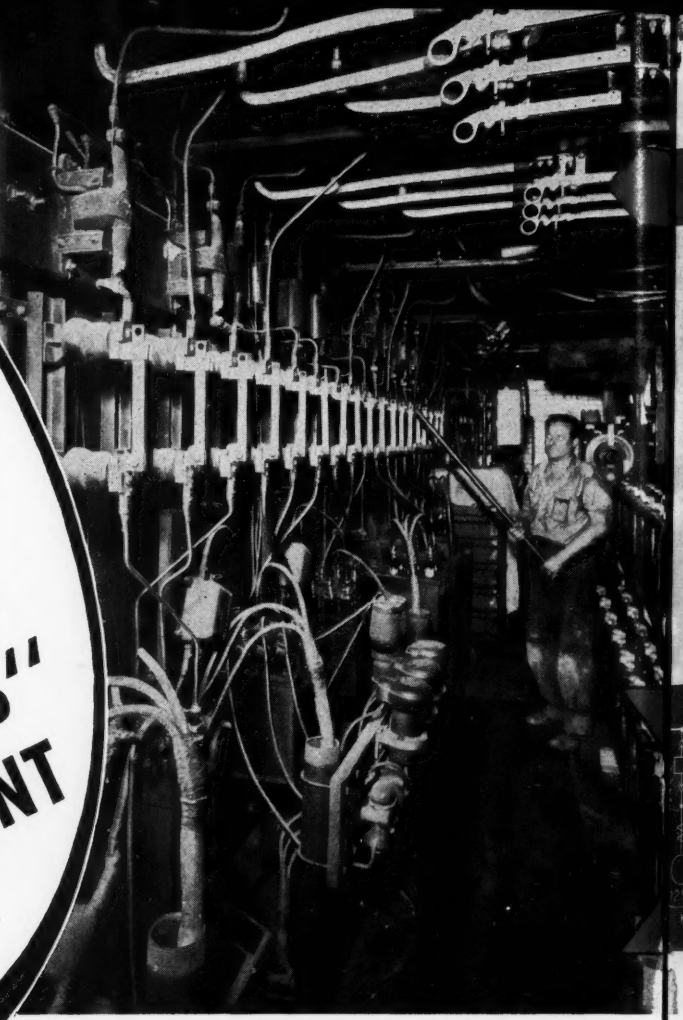
The loss to production of the 15,000 workers killed or injured every day means fewer ships, tanks, planes, guns, and other necessary war material. To reduce this loss of Manpower, this Company has subscribed to the National Safety Council's War Production Fund to Conserve Manpower.

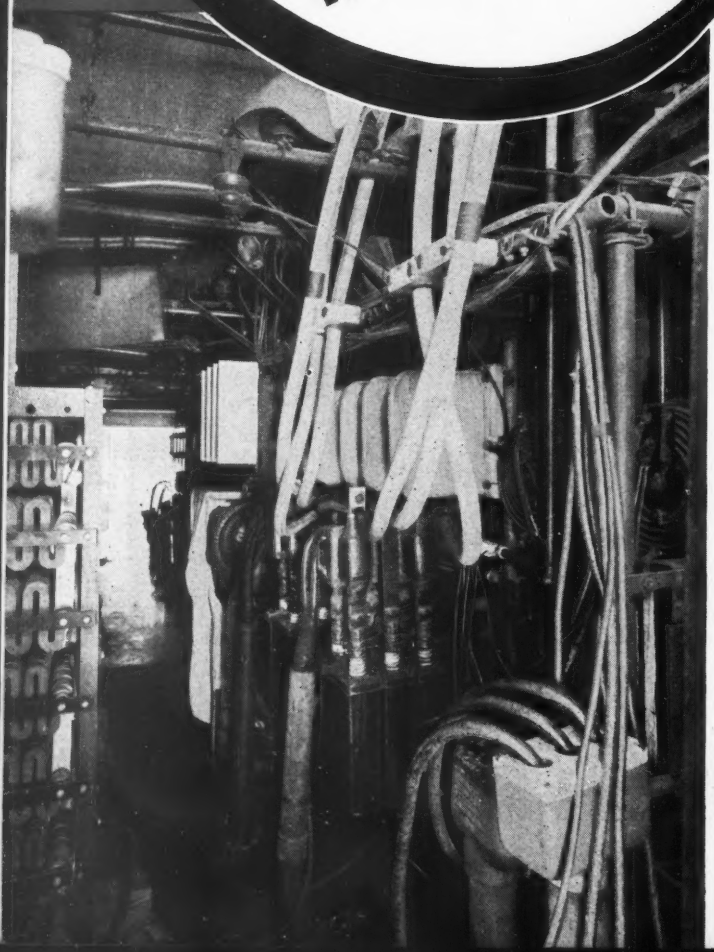
&WILCOX

85 LIBERTY STREET, NEW YORK, N. Y.

Watch Out

FOR "LIVE-WIRE ENTANGLEMENTS" IN YOUR PLANT





PROTECT PERSONNEL AND PRODUCTION WITH . . .

Safety-enclosed Switchgear

DANGEROUS "spiderweb switchgear" like this originates as strung-out, open-type switchgear, and grows more dense and more dangerous every year that additional devices are added. It often adds up to power interruptions and accidents to personnel.

That's why compact, safety-enclosed switchgear is going not only into today's new and enlarged plants but also into scores of existent plants to replace exposed, open-type assemblies. Industry knows that its job is far too big—and its man power too precious—to trust in haphazardly exposed devices.

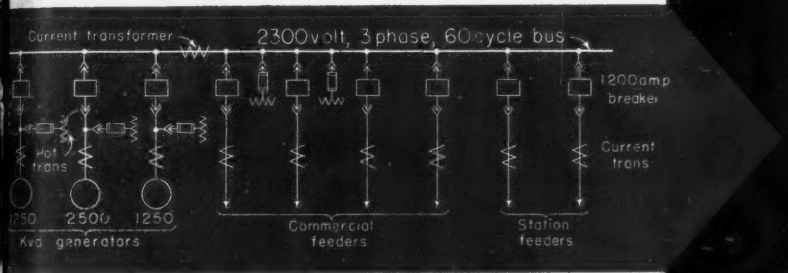
Today you can select, order, and install safety-enclosed switchgear in less time than ever before, because General Electric has ***standards*** to fill your needs. Standard load center unit substations, too, consisting of ***metal-enclosed*** switchgear and ***Pyranol*** transformers. Scores of war plants have kept in step with swelling power needs by installing these safe, compact, factory-assembled units instead of dangerous open-type assemblies. They give you long-term safety and dependability—save tons of vital copper.

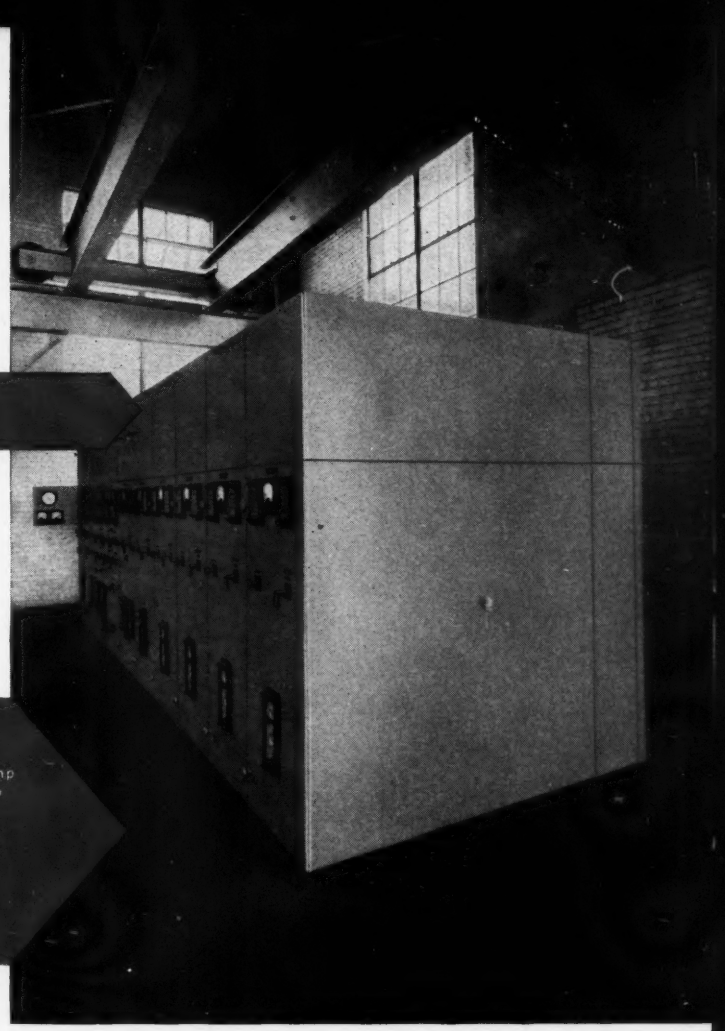
THIS DANGEROUS AISLE LINED WITH LIVE COPPER WAS WIPED OUT . . . .

. . . WHEN THIS MODERN SAFETY-ENCLOSED SWITCHGEAR WENT IN

. . . because metal-clad includes breakers and all associated equipment—instrument transformers, buses, and connections—in one safe, compact "package."

This simple, one-line diagram enabled us to put our switchgear factory right to work on the safety-enclosed units shown at the right.

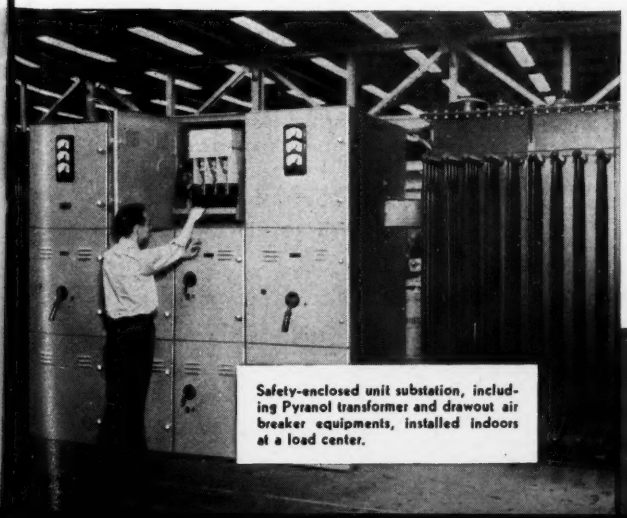




SAFETY-ENCLOSED UNITS LIKE THESE CAN BE INSTALLED . . . *QUICKLY*

With the one-line diagram of the electric system, General Electric engineers helped select *standard* switchgear that filled every requirement. It took a relatively short time to manufacture the standard units. They were shipped complete—on arrival, they had only to be set in place and connected.

The modern metal-clad switchgear with vertical-lift breakers took over the load, the old open-type apparatus was removed, and power was continued without interruption.



Safety-enclosed unit substation, including Pyranol transformer and drawout air breaker equipments, installed indoors at a load center.

. . . AND WITH TONS LESS COPPER

These metal-clad switchgear units took only 47 pounds of copper each—less than one-fourth as much as open-type assemblies for the same job. This is because compact, metal-clad construction does away with the many long, strung-out copper interconnections of open-type switchgear—replaces them with a few short ones. Also because copper disconnecting switches like those on the opposite page are entirely eliminated by modern, vertical-lift breakers that can, be quickly and easily connected and disconnected from the main buses.

Unit Subs Save Still More Copper

What's more, you can save immense amounts of cable copper by installing safety-enclosed unit substations—including *metal-enclosed* switchgear and *Pyranol* transformers—right at the center of the load area. Power can then be distributed to load centers at relatively high voltage. This means *short* secondary cables—and tons of copper saved.

Ask the nearest G-E office about *standard* G-E switchgear and unit substations. You can save time and copper, and get a new high degree of operating dependability and safety. ***General Electric, Schenectady, N. Y.***

The Navy "E", for Excellence, has been awarded to 92,780 General Electric employees in six plants manufacturing naval equipment.

GENERAL ELECTRIC

THIS LITTLE TRAP *is worth annually*

10 TIMES ITS WEIGHT IN BOILER METAL

1000 TIMES ITS WEIGHT IN COAL

Based on saving only 25 lbs. of steam per hr. per trap, the boiler metal necessary to generate this much steam would be ten or more times that used in the trap.

68 5000-ton tankers would be required for the oil that could be saved by 100,000 Armstrong Traps.

•

The coal that could be saved would be that carried by a train of 14,000 cars — seven tons per 14 lb. trap!

THE fuel-saving, labor-saving, money-saving advantages of Armstrong Steam Traps, important to prosperity in peacetime, have become vital weapons in wartime.

Based on conservative records of steam savings secured by users of Armstrong Traps, it is estimated that 100,000 Armstrong Traps would make the following contributions to the war effort:

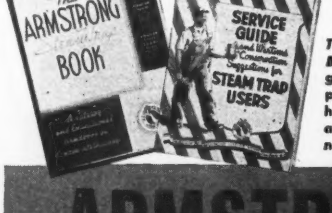
SAVE 14,000 carloads of coal in one year of 12 hour days.

OR, save the oil carried by 68 5000-ton tankers.

SAVE ten or more times their weight in boiler metal.

SAVE 100,000 man days a year in maintenance and operation alone, with no attempt made to estimate manpower savings made possible throughout a plant where the output of steam-consuming units is increased from 10 to 33% and more.

ADD to these advantages, the increased production, higher temperatures and closer control of processing made possible by Armstrong Traps and you'll agree they will help you get all-out output.



WRITE FOR

The Armstrong Steam Trap Book, a valuable guide to good condensate drainage practice. For additional helpful trap maintenance and hookup data, ask for new Service Guide.

There is an Armstrong Representative near you to discuss your condensate drainage requirements, or write direct.

ARMSTRONG MACHINE WORKS
810 Maple Street • Three Rivers, Michigan

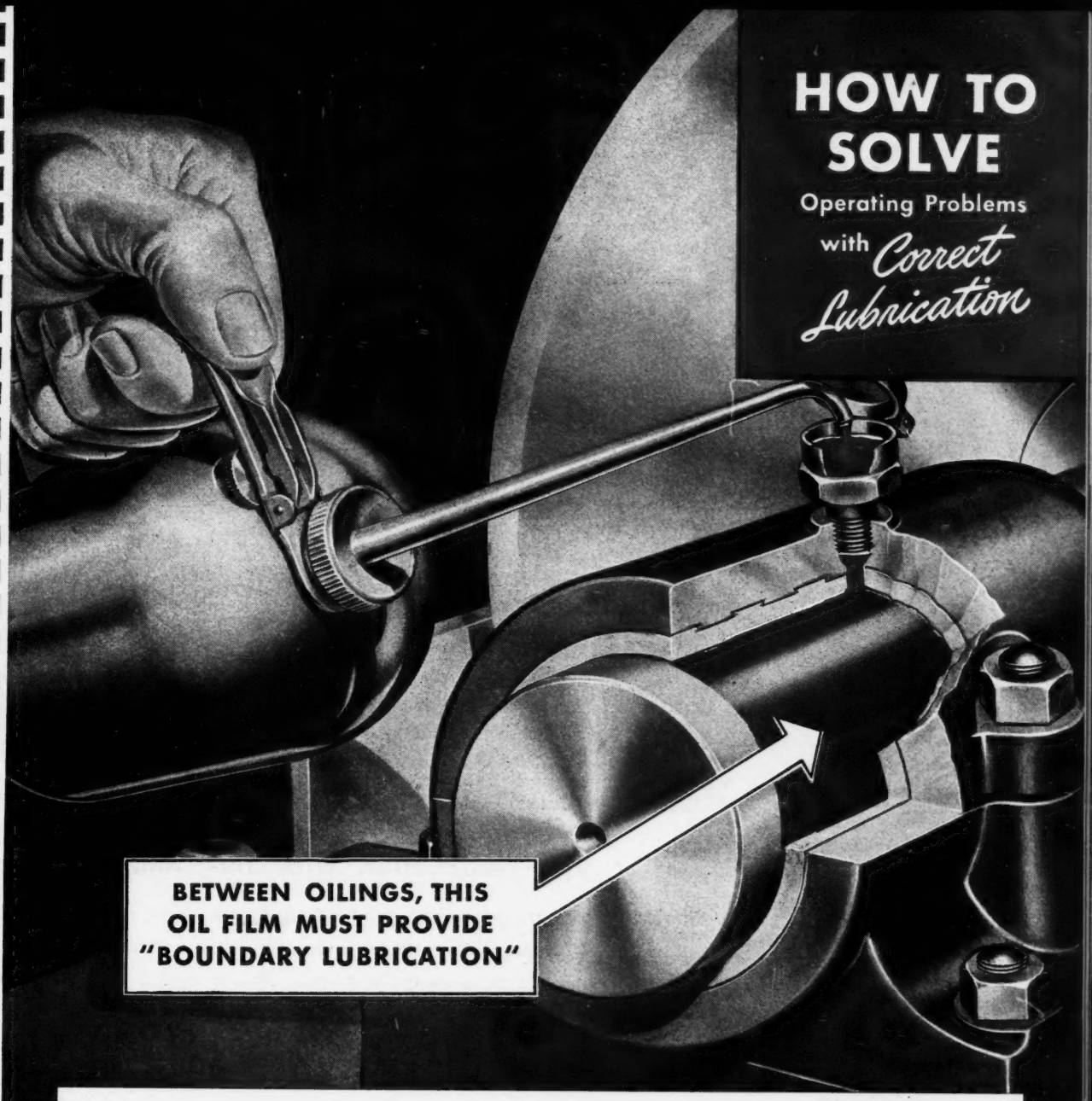
ARMSTRONG *Tested Capacity* STEAM TRAPS

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

HOW TO SOLVE

Operating Problems with *Correct Lubrication*



BETWEEN OILINGS, THIS OIL FILM MUST PROVIDE "BOUNDARY LUBRICATION"

Save Production Time Here!

PROBLEM: That red film of oil you see on the journal above is ample—at the time the bearing is oiled. But before the next application, the oil will drain off. Just a tissue-thin film — boundary lubrication — will remain. If you use ordinary mineral oil the film may not stand up. Metal-to-metal contacts between journal and bearing may result. Bearings fail. Important machines stop producing.

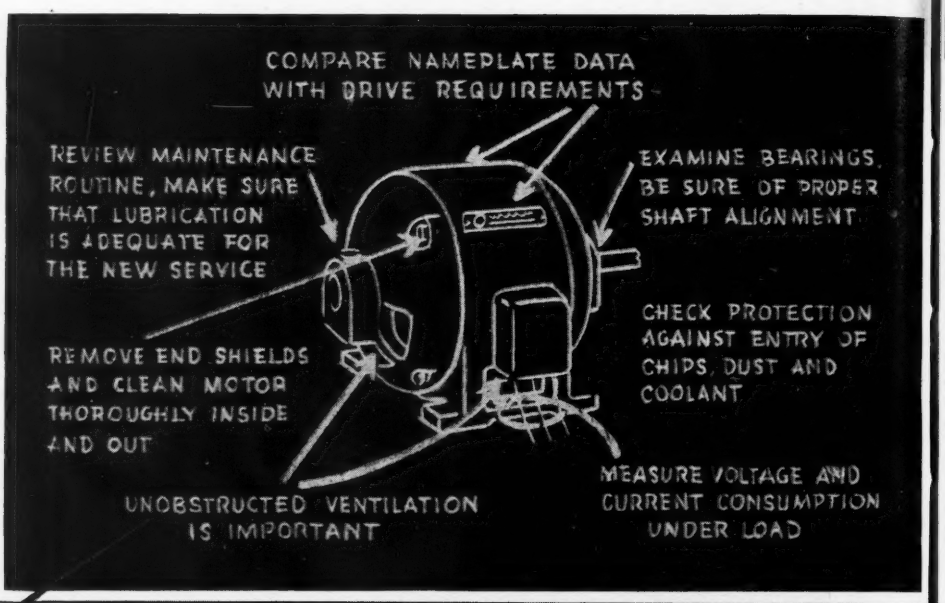
ANSWER: There is an oil specially made to meet this problem. It is called Gargoyle Vactra Oil. It has an extremely tenacious, persistent film that resists wiping action and rupture even when a film of microscopic thickness remains. Wear, temperature rise and power consumption are minimized with an extremely small supply of this oil. You are assured dependable operation and economy, too.

GARGOYLE Lubricants

SOCONY-VACUUM OIL COMPANY, INC.—Standard Oil of N. Y. Div. • White Star Div. • Lubrite Div. • Chicago Div. White Eagle Div. • Wadhams Div. • Southeastern Div. (Baltimore) • Magnolia Petroleum Co. • General Petroleum Corp.

CALL IN SOCONY-VACUUM

it's time to be a crank about


COMPARE NAMEPLATE DATA WITH DRIVE REQUIREMENTS
REVIEW MAINTENANCE ROUTINE, MAKE SURE THAT LUBRICATION IS ADEQUATE FOR THE NEW SERVICE
EXAMINE BEARINGS, BE SURE OF PROPER SHAFT ALIGNMENT
CHECK PROTECTION AGAINST ENTRY OF CHIPS, DUST AND COOLANT
REMOVE END SHIELDS AND CLEAN MOTOR THOROUGHLY INSIDE AND OUT
UNOBSTRUCTED VENTILATION IS IMPORTANT
MEASURE VOLTAGE AND CURRENT CONSUMPTION UNDER LOAD

protect your production with this maintenance plan

Planned motor maintenance, keyed to today's loads and conditions, saves vital hours of production time by forestalling future breakdowns and delay. In replacing hit-or-miss motor servicing with a regular schedule of trouble-*prevention*, you'll find real help in G-E *Motor Fitness Manual.*

The check list (right) tells what to do. The *Manual* tells how to do it, using well-proved methods that save time and help assure long-lasting motor service.

And, of course, your local G-E Motor Representative is always ready to aid you in putting these suggestions into practice, or in getting the new motors you may need for essential wartime jobs.

General Electric, Sec. G750-152
Schenectady, N. Y.

Yes, send me a copy of "Motor Fitness Manual," GED-1017.

Name.....

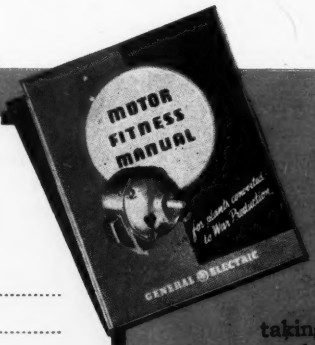
Title.....

Company.....

Address.....

City..... State.....

8030



MOTOR FITNESS MANUAL

. . . for plants converted to war production. Tells what to do to get the most out of motors, old or new. If you're undertaking new work on motor-equipped machines, if you're "switching" motors from one job to another, or equipping machines with new motors, you'll find this bookful of helpful motor facts will save you valuable time. Write for a copy.

MOTOR CARE

HERE'S WHAT TO DO!

1. Make sure that motors are selected to *match the job.* Install motors so they are properly aligned with the driven load and are easily accessible for regular inspection.

The G-E Motor Fitness Manual tells how

2. Keep motors free from dust and dirt. Establish a definite cleaning schedule.

The G-E Motor Fitness Manual tells how

3. Be sure that lubrication is frequent enough to take care of increased production. See that employees are instructed as to proper methods. Also guard against over-lubrication.

The G-E Motor Fitness Manual tells how

4. A general overhauling of hard-worked motors will add years to their life. If your motors haven't had an overhaul in the last year, try to arrange your production schedule to permit one as soon as possible.

The G-E Motor Fitness Manual tells how

***IF YOU NEED NEW MOTORS** for important war work, check with your G-E Motor Representative on how to get Tri-Clad motors quickly.*

The Navy "E", for Excellence, has been awarded to 92,780 General Electric employees in six plants manufacturing naval equipment.

BUILDER OF

TRI-CLAD MOTORS

REG. U.S. PAT. OFF.

GENERAL ELECTRIC

IT TOOK A-E-CO TAYLOR STOKERS TO LICK THIS TOUGH PROBLEM!

PROBLEM:

This plant had an unusual problem. It was so close to its coal source that buying new boilers or building an entirely new boiler plant would not produce the customary dollar savings in fuel. Yet, more steam was required than its two boiler plants could provide.

RESULTS:

For the year 1941, 3,505,543,000 lbs. of steam were generated from 333,517,600 lbs. of coal for an average evaporation of 10.51 lbs. steam per lb. coal, burning coal averaging 13,751 BTU per lb. coal as fired. Pressure 165 lbs. G., moisture in steam 1%, feed temperature to boiler 215° F. Combined efficiency 76.6%. Steaming range 50,000 to 150,000 lbs. per hour. Stoker maintenance 1.68c per ton of coal burned. Total tonnage was reduced about 35%, using coal costing about 30c less than formerly.

SOLUTION:

Many surveys and plans were made. Out of them all came the decision to modernize only one of the two boiler houses, installing 5 A-E-CO Hydraulic Taylor Stokers, each with a capacity of 150,000 lbs. steam per hour. The side walls and furnace roof were protected by A-E-CO water walls. Ten of the original 16 boilers were connected in tandem as shown in the side elevation.

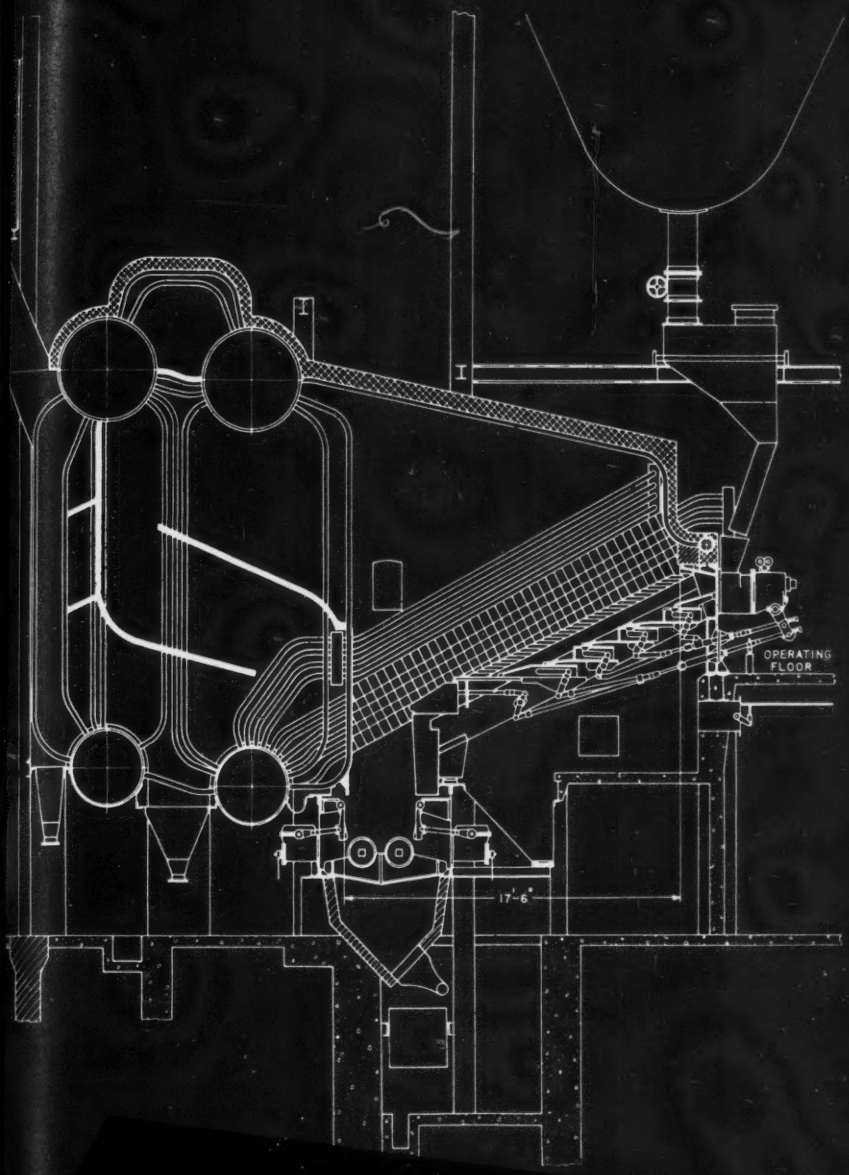
CONCLUSIONS:

Taylor Stokers were selected because they promise the largest return for the least expense. This case is a fine example of the adaptability of the Taylor Stoker to meet special conditions. Not only were the old boilers salvaged, but the capacity of the plant was increased, coal costs were substantially reduced, and only one-half of the former space was used.

ANOTHER CASE IN THE PAPER INDUSTRY

AMERICAN ENGINEERING

PHILADELPHIA PENNSYLVANIA



A-E-CO TAYLOR STOKERS ON THE FIRING LINE

*Aluminum Company of America, Edgewater, N. J.
*Aluminum Company of America, New Kensington, Pa.
American Tobacco Co., Inc., Durham, N. C.
Cantons Paper Company, Johnsonburg, Penna.
Chrysler Corporation, DeSoto Plant, Detroit, Mich.
*Collins and Aikman Corp., Roxboro, N. C.
City of Columbus, Ohio
Consolidated Paper Company, Monroe, Michigan
*Creason Stark Stabilizing, Cogan, Penna.
Delaware Milk Products Co., Delaware, Ohio
*DeLaval Steam Turbine Co., Trenton, N. J.
*Detroit Sulphite Pulp & Paper Co., Detroit, Michigan
City of Dover, Ohio
Draper Corporation, Hopedale, Mass.
Erwin Cotton Mills Co., West Durham, N. C.
*Fisher Body Corporation, Detroit, Michigan
Fisher Body Corporation, Fleetwood Plant, Michigan
*Fisher Body Corporation, Grand Rapids, Michigan
*Fisher Body Corporation, Pontiac, Michigan
Fox Paper Company, Lockland, Ohio
Froedtert Grain and Malting Co., Milwaukee, Wisc.
*City of Galion, Ohio
*Gardner-Richardson Company, Lockland, Ohio
*General Electric Company, Erie, Penna.
*General Electric Company, Fort Wayne, Ind.
*Greenwood Electric L. & W. Plant, Greenwood, Miss.
*Board Public Works, Hannibal, Mo.
Hill School, Pennsburg, Penna.
*Hobart Mfg. Co., Troy, Ohio
*City of Holland, Michigan
*Hope Natural Gas Co., Cornwell Station, West Va.
Hudepohl Brewing Co., Cincinnati, Ohio
Industrial Cotton Mills, Rock Hill, S. C.
*City Water & Light Plant, Jonesboro, Ark.
Kohler Company, Kohler, Wisc.
Maryland State Penal Farm, Roxbury, Md.
*Maybury Sanitarium, Northville, Michigan
Michigan Carton Company, Battle Creek, Michigan
*Michigan State College, East Lansing, Mich.
Municipal Light Plant, Marshfield, Wisc.
*Pacific Mills, Lyman, S. C.
*Packard Motor Car Co., Detroit, Michigan
Municipal Electric Plant, Painesville, Ohio
*Park Drop Forge, Cleveland, Ohio
*Pennsylvania Electric Co., Seward, Penna.
*Pennsylvania R. R. Co., Philadelphia, Penna.
*Picatinny Arsenal, Dover, N. J.
*Pittsburgh Plate Glass Co., Barberton, Ohio
Borough of Quakertown, Quakertown, Penna.
Raleigh Wyoming Mining Co., Glen Rogers, W. Va.
*Rhinelander Paper Company, Rhinelander, Wisc.
City of Richland Center, Wisconsin
*City of Richmond, Indiana
Sayles Bilthmore Bleachery, Biltmore, N. C.
Scotten Dillon Company, Detroit, Michigan
Shelby Cotton Mills, Shelby, N. C.
Sloane-Blabon Corp., Philadelphia, Penna.
*Solvay Process Company, Detroit, Michigan
*St. Elizabeth's Hospital, Washington, D. C.
City of St. Bernard, Ohio
Swarthmore College, Swarthmore, Penna.
*Timken Roller Bearing Co., Canton, Ohio
Timken Roller Bearing Co., Gambrinus, Ohio
Municipal Water & Light Plant, Tippecanoe City, O.
City of Toledo, Ohio
*Union Bleachery, Greenville, S. C.
Union Mills Paper Mfg. Co., New Hope, Penna.
*University of Wisconsin, Madison, Wisc.
*Vassar College, Poughkeepsie, New York
*Borough of Vineland, New Jersey
Wasfield Natural Gas Company, Harold, Kentucky
White Sewing Machine Co., Cleveland, Ohio
Whiting Plover Paper Company, Stevens Point, Wisc.

(*) Represents repeat orders

A-E-CO TAYLOR STOKER

A-E-CO TAYLOR STOKERS
WATER WALLS • ASH HOPPERS
SHAW FLUID POWER
MARION-DECK AUXILIARIES
CO-HED HOISTS

COMPANY

BEFORE YOU BUY ANY FUEL FIRING EQUIPMENT CONSIDER EACH OF THESE 12 FACTORS

1. **RELIABILITY**—the ability to operate with minimum outage and minimum standby equipment.
2. **CAPACITY**—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.
3. **MAINTENANCE**—the ability to operate continuously with minimum repair costs.
4. **FLEXIBILITY**—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.
5. **EFFICIENCY**—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.
6. **OPERATION**—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.
7. **ADAPTABILITY**—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.
8. **FUEL FLEXIBILITY**—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.
9. **REFUSE DISPOSAL**—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.
10. **STACK DISCHARGE**—the practical elimination of "smoke nuisance" without special equipment.
11. **SPACE REQUIREMENTS**—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.
12. **OBSOLESCENCE** — the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

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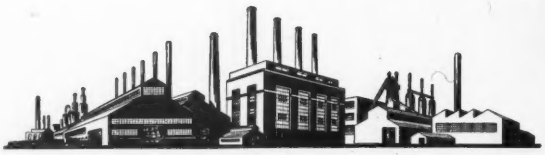
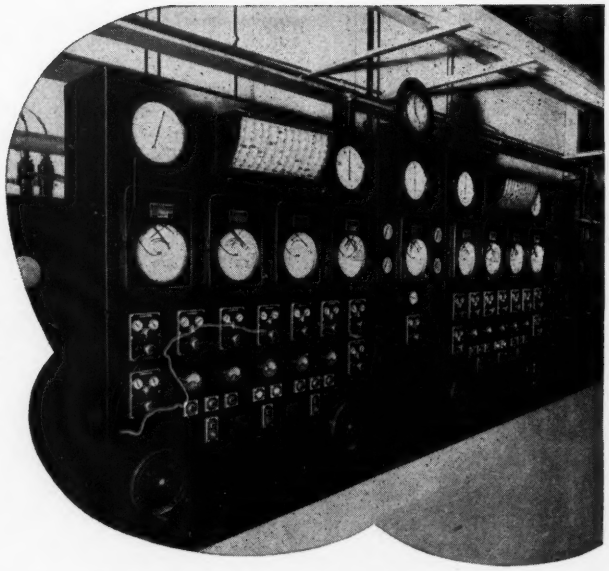


This Bailey Boiler Control Panel serves multi-fuel fired boilers in a Steel Mill.



WAR STRATEGY for POWER ENGINEERS

1. Make Full Boiler Capacity Available
2. Conserve Fuel and Man Power
3. Prepare to Train New Operating Crews
4. Take Steps to Insure Continuity of Service
5. Protect Men and Equipment Against Accidents

★ Our fighting forces will win the war if our productive forces do not lose it by delivering" too little and too late." Every Power Engineer should map his war strategy now. We offer the following suggestions;

1. Make Full Boiler Capacity Available—by cleaning and repairing boilers and furnaces, by providing sufficient natural or mechanical draft, by continuously maintaining excess air at the minimum economical value, by careful fuel selection, and by basing both manual and automatic operation on accurate measurements.

2. Conserve Fuel and Man Power—by use of a coordinated boiler control for combustion, feed water, superheated steam temperature, heater and storage tank levels. The combustion control system should automatically make any readjustments necessary to maintain maximum fuel economy.

3. Prepare to Train New Operating Crews—by writing a clearly worded schedule of operator's duties, by reducing operation to its simplest form through the use of meters and control.

4. Take Steps to Insure Continuity of Service—by setting up a schedule for routine inspection of power equipment, by improving and coordinating operation to avoid unnecessary strain on any of the units in the system. Complete combustion control and properly applied feedwater control systems are of great aid in maintaining uniform safe operation.

5. Protect Men and Equipment Against Accidents—by the addition of interlocks and alarms to the boiler control system. Serious accidents resulting from fan failure, flame failure, high or low water levels, and other unusual conditions may be avoided by these devices.

It is hoped that the foregoing suggestions may give you some help in formulating a war strategy which will help to keep your plant out of the "too little and too late" group. We shall be glad to make specific recommendations on how to include metering and control equipment in your war strategy. A-82

BAILEY METER COMPANY
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BAILEY METER CONTROL

The Complete Combustion Control System

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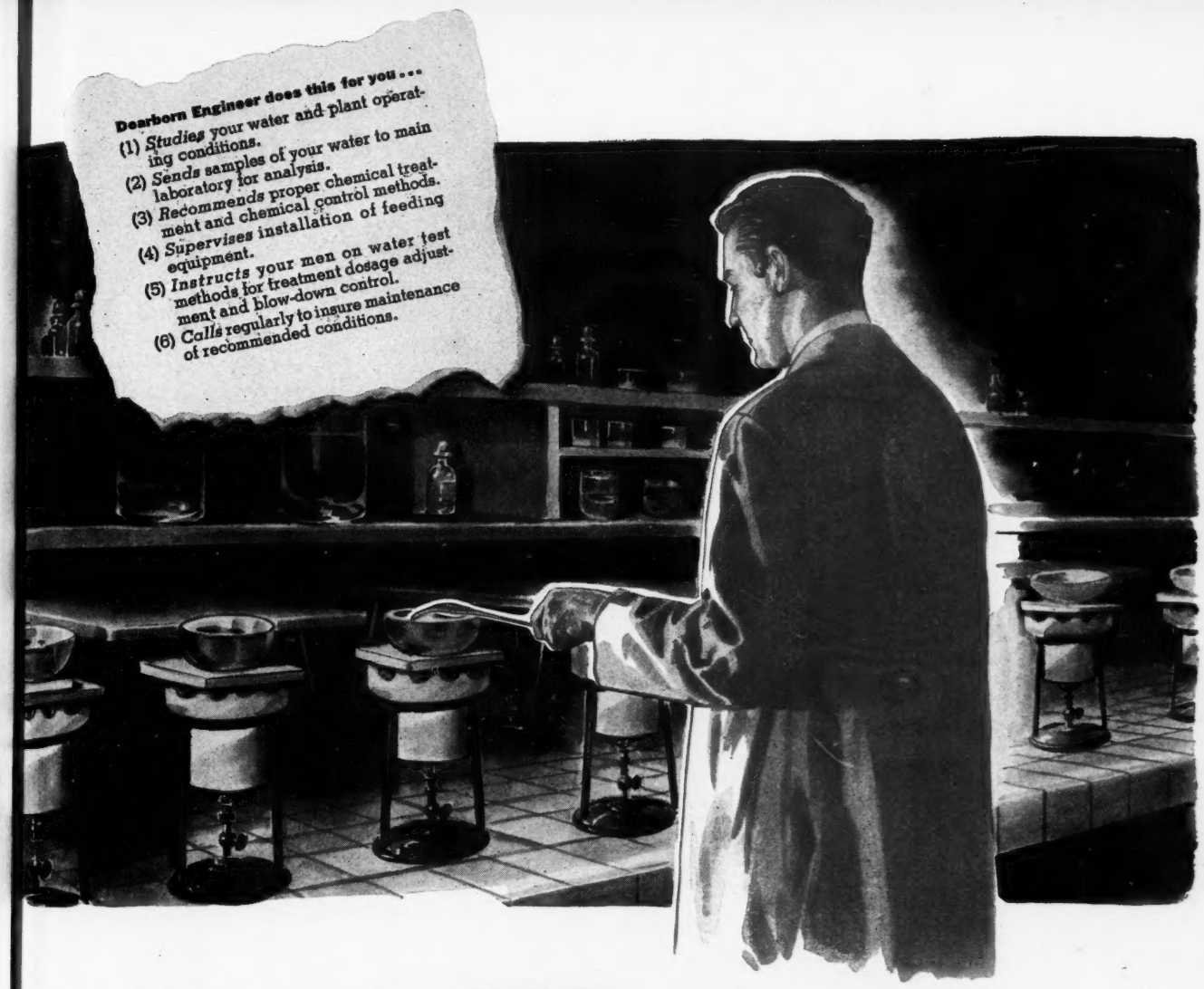
Dearborn Engineer does this for you...
(1) Studies your water and plant operating conditions.
(2) Sends samples of your water to main laboratory for analysis.
(3) Recommends proper chemical treatment and chemical control methods.
(4) Supervises installation of feeding equipment.
(5) Instructs your men on water test methods for treatment dosage adjustment and blow-down control.
(6) Calls regularly to insure maintenance of recommended conditions.

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He knows your water because he lives and works where your plant is located. He is quick to detect trouble which is aggravated by the use of the wrong treatment. He is equally quick to detect trouble caused by incorrectly using the right treatment. In fact, he's an expert in preventive treatment to avoid trouble. This preventive treatment starts by knowing your water and concludes with installing and servicing the proper method of control. Over 8000 power plants of every steam producing capacity in all parts of the country depend upon Dearborn service.

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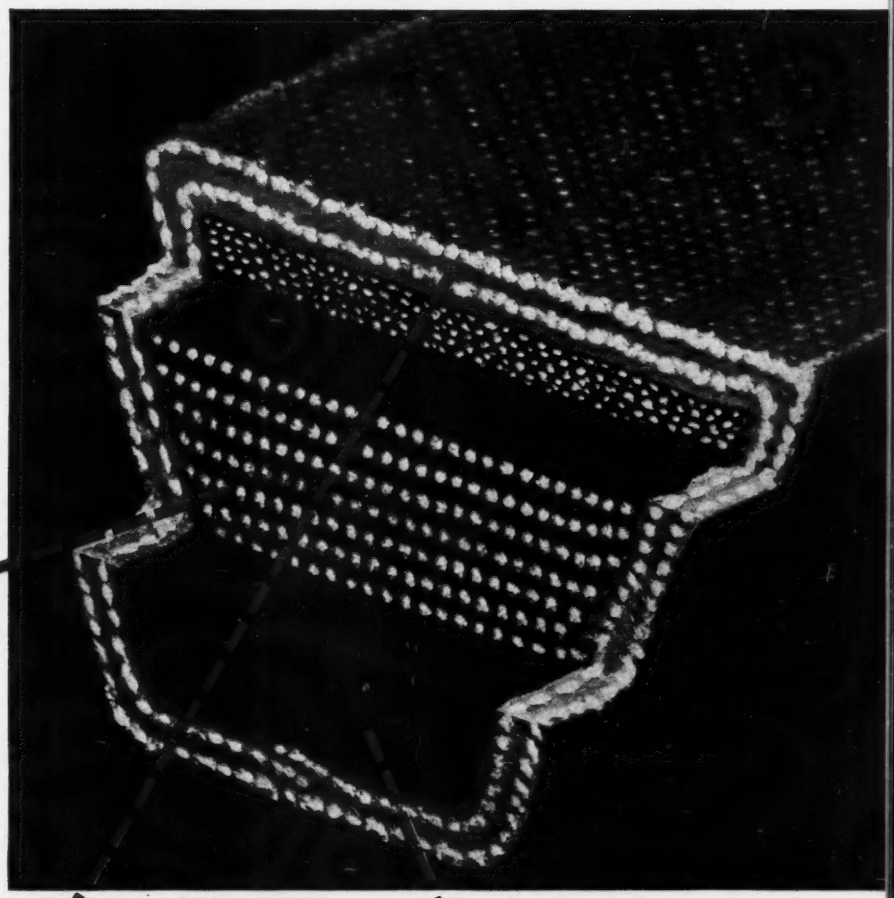
Anatomy of Maintenance

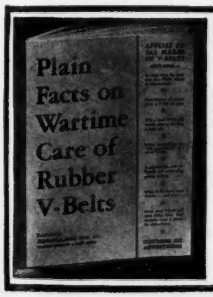
WARTIME V-BELT

You'll find this Cutaway of the new, advanced Texrope Super-7 well worth a Moment's Study... for how it's *Built* tells you a Lot about how to *Care* for V-Belts — whatever "Make" you Use! And proper Care of the rubber V-belts driving around 70% of America's production machines is a Wartime *must!*

V-Day needs every V-Belt



MUSCLE . . The 50% stronger cords and 20% *more* cords produced by the Flexon process give the new Texrope Super-7 extra muscle. To protect the pulling strength of *your* V-belts — regardless of their brand — keep them pulling *steadily*... without the slipping and grabbing that can jerk the life out of V-belts. That means keeping proper tension. Good rule-of-thumb for measuring it: "When struck with the hand, properly taut V-belts have an alive springiness."



Free!

Every engineer and executive should have a copy of this valuable new handbook in his technical library. It's packed with timely facts... applies to *all* makes of V-belts. Send for it today!

SKIN . . Texrope Super-7's tough, new Duplex-Sealed cover protects the inner belt structure against grit, grime and moisture. And what protects any V-belt's *cover* is — maintenance! So here are 3 rules for care of covers . . . 1. Keep grease or oil from reaching them — quickly remove it with a solvent if it does (*never* apply belt dressings to rubber V-belts!); 2. If gritty dust threatens abrasive wear, shield your V-belts; 3. Maintain proper tension to prevent slip and heating.

PAD . . Just as the bones of the human foot "ride" on the sole's pad of fat, so the pulling cords of a V-belt "ride" on a pad of rubber... which eases them around sheaves. Texrope Super-7's pad is of special, cool-running rubber which combats heat, dangerous enemy of rubber. *You* can fight heat by preventing misalignment in your drives. When present, it subjects the sides of V-belts to needless rubbing, sharply raises belt temperatures. So keep the shafts of drives parallel, sheave grooves in line.

☛ *When you do Need new V-belts, invest in the Best...Texrope Super-7!*

A 1545

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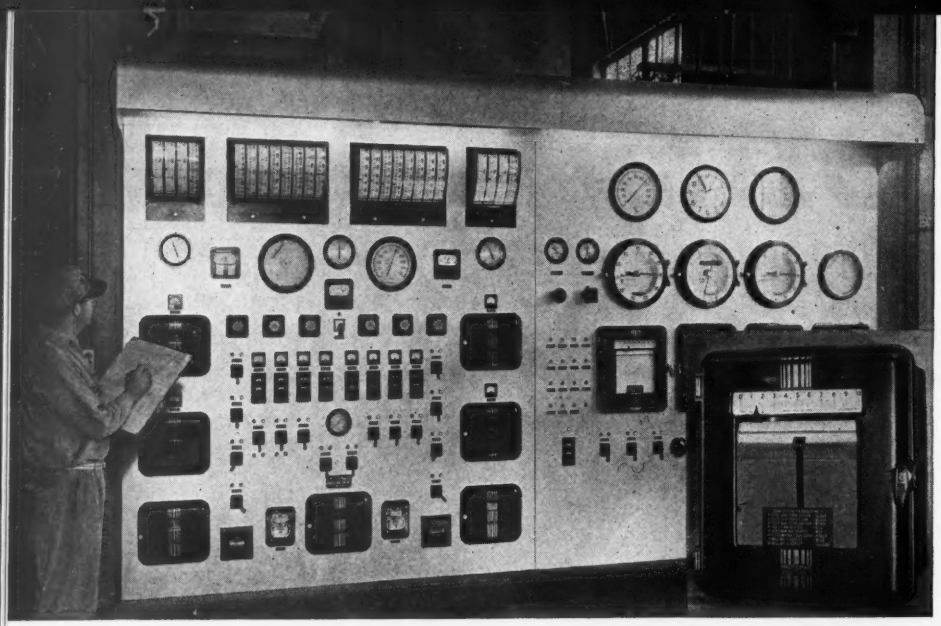


A central station arranged its L&N boiler-control equipment as shown here. Included are Metermax Combustion Control, Micromax Round-chart Recorders for superheated steam, steam purity and CO_2, and a Micromax Strip-chart Recorder for air, gas and water temperatures.

Micromax Recorder with tear-off device which makes removal of day's record as simple as removal of a round chart.

STRETCH YOUR MANPOWER

With Instruments & Controls by L&N

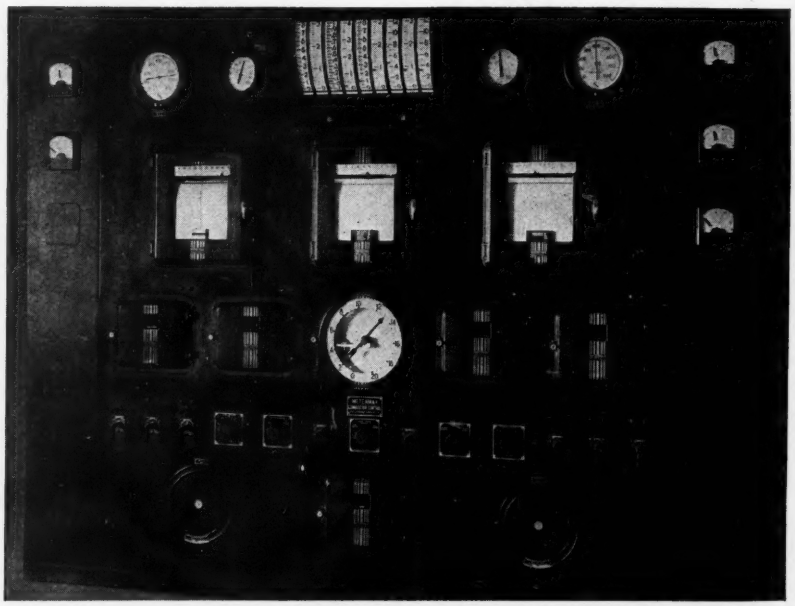
Supplied one at a time, or in completely-assembled panels, L&N's dependable, fully-automatic instruments and controllers are helping many a power plant which must stretch its remaining manpower. Typical groups of equipment are shown here.

Micromax Flow Recorder. For accurate determination of steam and water flow. The meter-body is the revolutionary, highly precise Centrimax (centrifugal-force) machine. Integrating and recording are separate, independent functions; neither affects the other. Integration is on the Recorder's counter; rate-of-flow is shown on record in typically thorough, visible, finely-detailed Micromax fashion. Recorder may be Strip-chart or Round-chart. For further information, write us or see Catalog N-28-160, 1942 edition.

Micromax Temperature Recorders. Multipoint instruments supplying multicolor (or single-color) records of temperatures of steam, gas, air, water, from any points at which thermocouples or Thermohms (resistance - thermometer bulbs) can be located. Records are extremely legible. Instruments may be equipped for automatic control of superheat. For further information, write us.

Micromax CO_2 Recorder. The simple, accurate, sensitive equipment which requires hardly more attention than does a pyrometer. Can be either a guide to manual adjustment of combustion, or can automatically operate fuel-air ratio setting of Metermax Combustion Control. For further information, write us, or see Catalog N-91-163, 1941 ed.

Metermax Combustion Control. For helping boiler furnaces meet any load conditions, without sacrifice of efficiency. Combines the sensitivity of electric control with the simplicity of pneumatic, to form equipment of outstanding dependability for medium and large plants. For further information, write us, or see Catalog N-01-163, 1939 ed.



Boiler-control panel in the powdered-coal power plant of a cement mill. Recorders, left to right, are Micromax for feedwater-flow; Micromax multipoint multicolor for temperatures of gas, air, feedwater and superheated steam; Micromax multipoint multicolor for temperatures of condensate and makeup; and, below, Micromax CO_2 Recorder. Shown also is complete Metermax Combustion Control. Complete assembly and wiring of this panel was done by L&N.

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LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA., PA.

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Entrusted with this important job aboard many battleships, aircraft carriers, destroyers, cruisers and other U. S. Naval units, is the new rust-preventive Shell Turbo Oil . . . lubricating not only heavily loaded main and thrust bearings but also reduction gears which must run at terrific rubbing speeds and under heavy pressures.

Shell Turbo Oil can survive these extreme operating conditions because it has *all 3* characteristics necessary to the proper lubrication of modern turbines:

RUST PREVENTION
SUPERIOR OXIDATION STABILITY
MINIMUM FOAMING TENDENCY

Call in the Shell man now for full details.

RUST-PREVENTIVE
SHELL TURBO OIL
A name to Remember
SHELL

"You're depending on us..."

"...and we're depending on you!"

We at home are relying on the courage of our fighting men to protect the things we hold dear. But courage alone cannot win battles. Our men are counting on us for a continuous supply of guns, shells, tanks, ships, planes, bombs, food.

Let's not let them down. Let's maintain peak production by avoiding waste, working hard and buying War Bonds!

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THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Manufacturers of GARLOCK Packings, Gaskets and KLOZURE Oil Seals

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in the Steel Tube Industry

Electroweld STEEL CORPORATION

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The Electroweld Steel Corporation recently completed America's most up-to-date, continuous, electric resistance welded tube mill for the production of pressure tubing and mechanical tubing. The refinements incorporated in this mill provide an improved product with a silver-bright surface. Precision control over the entire production operation lends uniformity of structure in the weld area, and thus ELECTROWELD Steel Tubing has a homogeneous structure throughout. This new mill not only forms tubing more accurately to size than commercial tolerance requirements, but it also permits greater uniformity of wall thickness, weight, and ductility. Furthermore, no other steel tubing is cut off so smoothly.

Electroweld Tubing goes to war in an amazing quantity. Another mill, now being built, will increase Electroweld production. When victory be ours, we trust that our type of products will fit into your peacetime operations.

Electroweld STEEL CORPORATION · OIL CITY · PENNA.

HOW TO MAKE YOUR MULTIPLE-

...WITH LESS OUTAGE AND LOWER MAINTENANCE

If yours is one of the many plants operating multiple-retort underfeed stokers, here are some suggestions that will help you get longer life out of your present equipment and minimize outage for repairs or replacements. While they relate primarily to the C-E multiple-retort stokers here illustrated, they are largely applicable to all stokers of this general type.

OPERATION

GENERAL The two main causes of excessive outage and maintenance are (1) sustained or frequent overloading of stoker and (2) operating with insufficient draft.

Where prolonged overloading is unavoidable, as is often the case in these days, good operation and careful attention to maintenance are especially important. Frequently, in such cases, the use of a higher quality coal, well suited to underfeed stoker operation, will make it possible to carry the increased load without excessive outage or maintenance costs.

Observe fuel bed and furnace conditions frequently. It is easier to correct unsatisfactory conditions in the early stage before serious difficulties develop.

FIRE (1) Keep fire out of retort. This condition can result from too thin a fuel bed, from banking with insufficient fuel or from running with an empty hopper.

(2) Keep coal hopper well filled. Avoid segregation of coal sizes in hopper. Use mechanically-operated swinging spout, traveling larry or non-segregating spreader chute. A uniform mixture is absolutely essential to a good fuel bed.

(3) Be sure fuel distributes uniformly over the stoker. The stroke of the secondary rams can be adjusted at the front of the stoker to control distribution.

(4) Operate so that lower ends of bars in the overfeed section, adjacent to the ash disposal section, are always covered—6 in. to 9 in. deep is about right. This is particularly important on dump grate equipped stokers after the ash has been dropped. Lengthen stroke of rams and overfeed section to assure this condition if necessary.

(5) Always feed in sufficient fuel when banking. Build up fuel bed at front of stoker. Reduce air supply gradually to permit protective layer of ash to form next to the grate. Never cut off air completely under active fuel bed. It may be necessary to operate stoker occasionally when on bank to prevent fuel bed from burning down into retorts.

(6) Do not permit too much refuse to accumulate on dump grates or in ash pit. See that refuse moves away properly on continuous discharge and clinker grinder type stokers.

(7) Depth of fuel bed is very important. If too thin, fire may burn down into retort and damage retort sides. If too heavy, poor air distribution will result, causing spotty, uneven fire; holes in fuel bed; smoke and reduced efficiency. Correct depth of fuel bed above top of tuyeres may be anywhere from 16 in. to 20 in., depending upon analysis and burning characteristics of coal used.

DRAFT (1) Draft gage and a CO_2 indicator are essential to good operation.

(2) Always operate with some draft above the fuel bed—preferably not less than .10 in. The entire furnace, however, should be kept under negative pressure. Plus pressure causes excessive temperatures often with destructive effect on stoker and setting.

(3) Maintain proper air supply at all times. The best indicator is the CO_2 reading. Establish, experimentally, the proper CO_2 reading for *your* conditions and then operate accordingly. Don't guess.

(4) Some air should be allowed to pass through grates at all times. On bank open windbox access doors to admit air for cooling grates.

(5) If draft is insufficient, check leaks in setting and losses through boiler and flue connections; check position of boiler damper. Careful checking will usually disclose conditions that can be improved.

CLEANING (1) Remove siftings from windboxes often enough to prevent any possibility of fire under grates. Frequency of cleaning depends upon type of fuel used, but windboxes should be inspected once every shift.

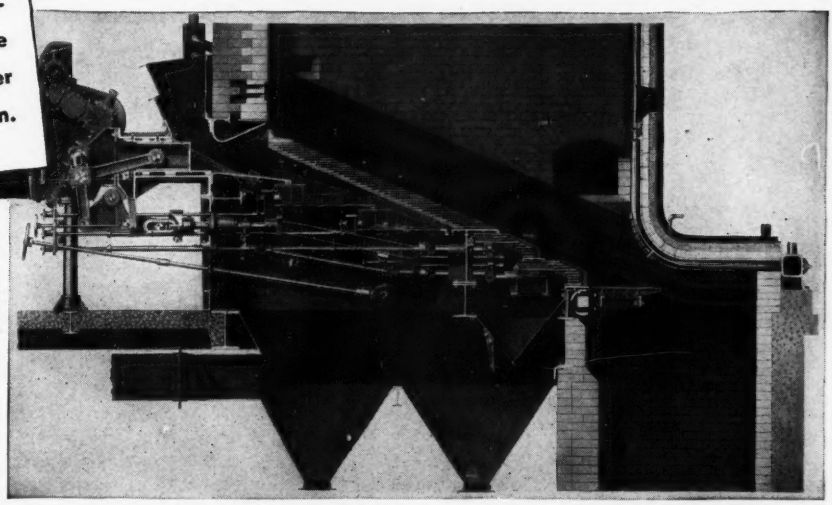
(2) Keep front of stoker clean to prevent contamination of lubricants and excessive wear on moving parts.

INSPECTION AND MAINTENANCE

(1) All accessible parts of the stoker should be inspected daily. Those parts which cannot be examined

RETORT STOKERS LAST LONGER

If this information is not of immediate interest to you, please see that it reaches the proper man in your organization.



C-E Multiple Retort Stoker

while the stoker is in service should be thoroughly inspected at least twice a year and more often if practicable. If conditions permit, it is desirable about once a week, when load is light, to burn down fire on rear of stoker, feed off the refuse and observe condition of lower end of stoker.

(2) On daily inspections, look especially for loose bolts and loose connections in moving parts. Where movement is transmitted by sheer pin, or safety release, be sure there is no binding which might prevent protective device from serving its function. Make repairs or replacements promptly.

(3) When stoker is shut down, make thorough inspection. Check wear on surfaces of retort sides and ram boxes. (If they are allowed to get too thin before replacement, serious outage will result.) Check wear on moving parts, check alignment. Check condition of dump grates and tuyeres.

(4) Check adjusting mechanism that controls secondary rams and overfeed section occasionally to be sure that the actual travel corresponds with indexing plate at front of stoker.

(5) Check stoker dampers in open, closed and intermediate positions. Adjust when necessary.

(6) On clinker grinder stokers check rolls and cutters from time to time. Replace broken or badly worn cutters to assure proper grinding.

(7) Make minor repairs as soon as need is apparent. Keep replacement parts on hand. A serious outage may thus be averted.

LUBRICATION

The use of the right lubricants at sufficiently frequent intervals at all points requiring lubrication is essential if unnecessary outages and excessive maintenance are to be avoided. Difficulties from inadequate lubrication usually result from a lack of attention rather than a lack of knowledge as to how, when and where to lubricate. A definite schedule for lubrication, regularly adhered to, is the answer.

The C-E line of stokers is the most extensive on the market. It includes single-retort, multiple-retort, spreader, traveling and chain grate types.

OVER 17,000 C-E STOKERS HAVE BEEN PURCHASED TO DATE

Reprints of this advertisement available on request.

A-696

COMBUSTION ENGINEERING

200 MADISON AVENUE, NEW YORK, N.Y.

In Iowa - Where the Tall Corn Grows

YARWAY CYLINDER-GUIDED EXPANSION JOINTS

Welded Wrought Steel. Single and double types with flanged or welding ends. Small diameter—no large tunnel space required. Made in two types—the conventional Gland-Pakt type and the revolutionary Gun-Pakt type which permits packing under full steam pressure. Catalog EJ-1908.

YARWAY SEATLESS BLOW-OFF VALVES

Yarway Seatless Blow-Off Valves have been proved by a generation of satisfactory service in more than 12,000 plants. No seat to score, wear and clog with mud, scale and dirt. Write for Catalog B-422 for pressures up to 400 lbs; B-431 for higher pressures.

Yarway Products Help Make Corn Products in the Great Plant of Penick and Ford, Inc.

YARWAY IMPULSE STEAM TRAPS

Insure quick heating and greater sustained heating efficiency. Light in weight. Small size. Low price. Easily installed and serviced. Operate on exclusive *Impulse* principle. Six sizes serve practically all requirements. Send for Catalog T-1737.

YARWAY

YARNALL-WARING CO., PHILADELPHIA

They all add up to the one

More steam

HAGAN CONTROL ASSURES –

+ MAXIMUM quantity of steam from any given plant, by introducing fuel and air in correct proportion for utmost efficiency.

+ MAXIMUM utilization value, uniform steam pressure and temperature, in accordance with demand.

+ MAXIMUM output from boilers of differing capacities, automatically.

+ MAXIMUM steam for production, by reducing loss of steam in frequent soot blowing.

+ MAXIMUM PROTECTION of auxiliary equipment, fans, stokers, etc. by maintenance of uniform operating conditions.

= Greater production for war effort

thing you want most...

for the war effort!

NOTHING in steam boiler equipment is more important to the constant carrying of a war load than AUTOMATIC COMBUSTION CONTROL. It must be adequate, reliable, able to take from your shoulders the responsibility for constant attention . . . to give the utmost freedom from manual adjustment. It should be dependable even if you had to go away in an emergency and leave it.

HAGAN AUTOMATIC COMBUSTION CONTROL will give you that kind of service. It will give it under the most trying conditions. It will assure you instant functioning with the slightest changes in steam header pressure. Since it is *air operated,* Hagan Control assures fast, positive action and remarkable freedom from trouble. Hagan Control installations set up years ago are giving the same excellent service they did in the beginning.

Correct engineering on the soundest principles is the reason for Hagan performance — taking infinite pains to assure the greatest design simplicity and the utmost in flexibility to meet varying plant conditions.

You have a right to expect such results from the pioneers who from the beginning have set the pace for this field. If you are not getting such results from the equipment you are now using look into this. Call for a Hagan combustion specialist . . . Now . . . and put an end to your trouble.

SPECIFIC ADVANTAGES OF HAGAN AUTOMATIC COMBUSTION CONTROL

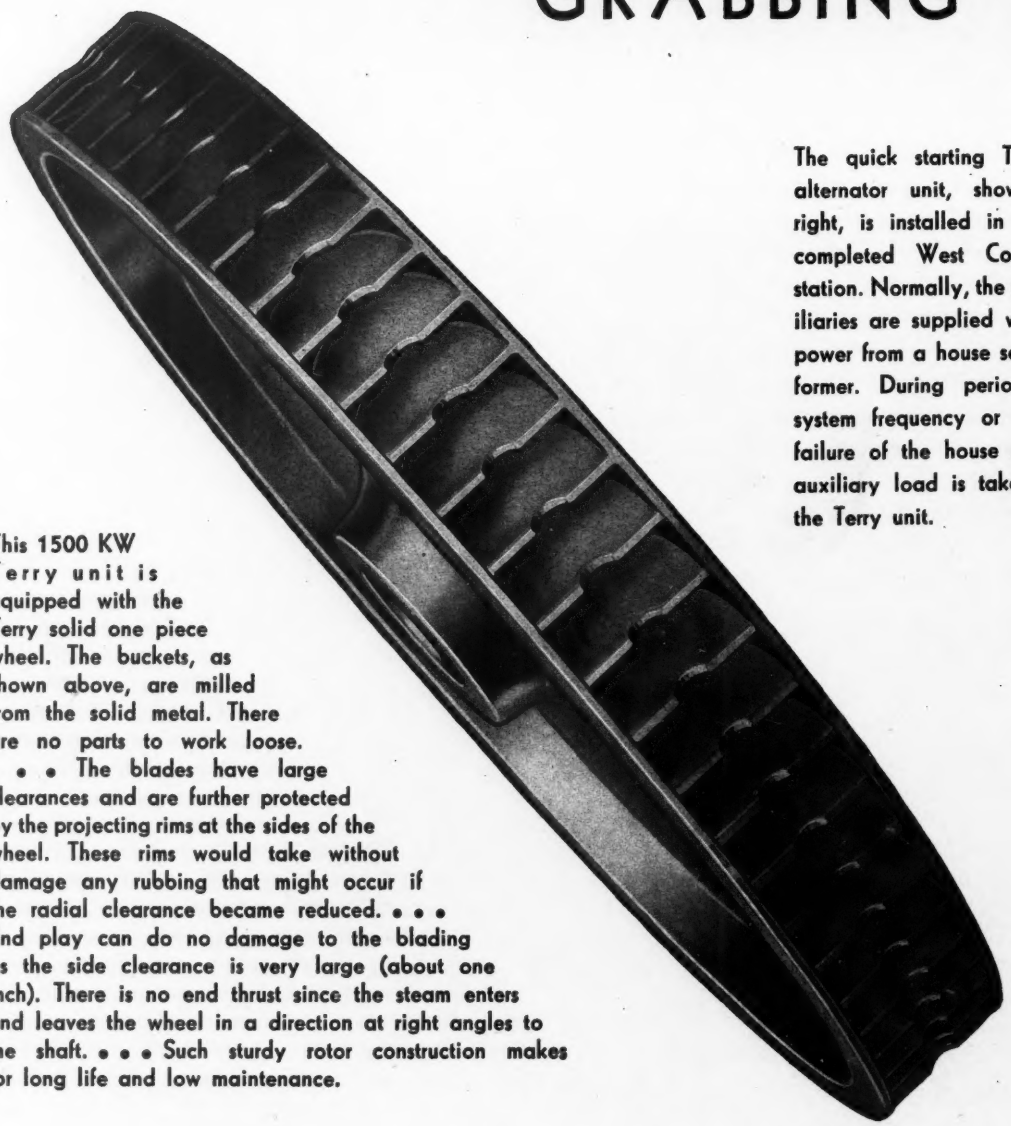
Simplicity of operation.
Ease of installation.
Ruggedness of equipment.
Sensitivity to small load changes.
Accuracy of adjustments for small variations.
Speed of movement, with stability, throughout operating range.
Flexibility in meeting individual plant conditions.
Engineered by the pioneers and leaders in automatic combustion control.

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH, PA.

HAGAN *Automatic* COMBUSTION CONTROL
The pioneer . . . and still the leader

The TERRY

GRABBING A 1



This 1500 KW Terry unit is equipped with the Terry solid one piece wheel. The buckets, as shown above, are milled from the solid metal. There are no parts to work loose. • • • The blades have large clearances and are further protected by the projecting rims at the sides of the wheel. These rims would take without damage any rubbing that might occur if the radial clearance became reduced. • • • End play can do no damage to the blading as the side clearance is very large (about one inch). There is no end thrust since the steam enters and leaves the wheel in a direction at right angles to the shaft. • • • Such sturdy rotor construction makes for long life and low maintenance.

The quick starting Terry turbo-alternator unit, shown at the right, is installed in a recently completed West Coast central station. Normally, the station auxiliaries are supplied with electric power from a house service transformer. During periods of low system frequency or in case of failure of the house service, the auxiliary load is taken over by the Terry unit.

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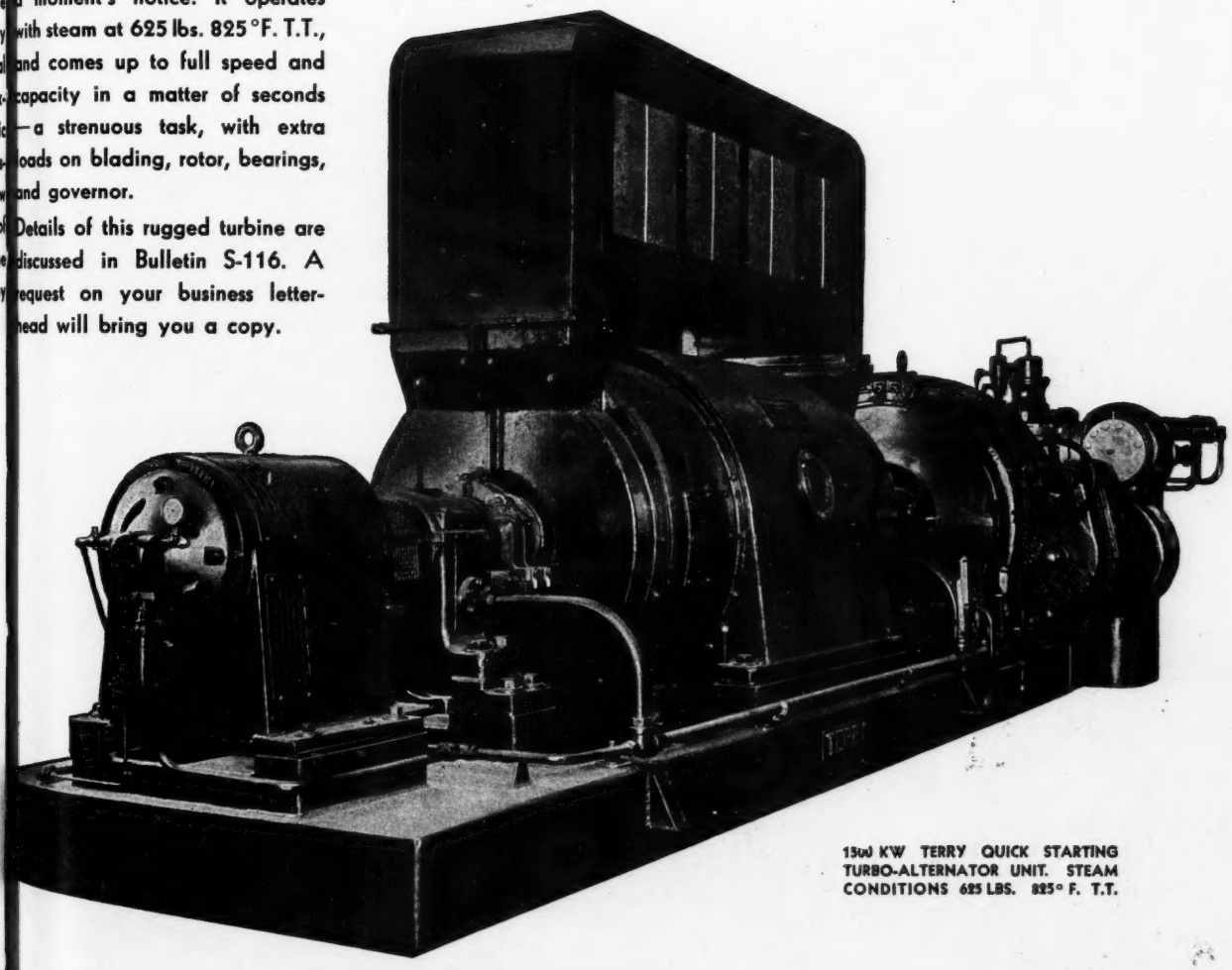
THE TERRY STEAM TURBINE CO.

Wheel Turbine

1500 KW LOAD ON A MOMENT'S NOTICE!

The unit is ready to take over on a moment's notice. It operates with steam at 625 lbs. 825°F. T.T., and comes up to full speed and capacity in a matter of seconds —a strenuous task, with extra loads on blading, rotor, bearings, and governor.

Details of this rugged turbine are discussed in Bulletin S-116. A request on your business letterhead will bring you a copy.

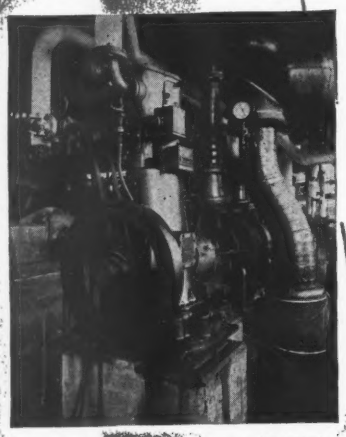


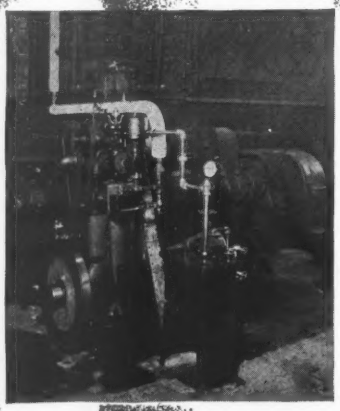
1500 KW TERRY QUICK STARTING TURBO-ALTERNATOR UNIT. STEAM CONDITIONS 625 LBS. 825° F. T.T.

T-1150

TERRY SQUARE - HARTFORD, CONN.

Links in a Nation-Wide chain of TROY-ENGBERG BY-PRODUCT POWER

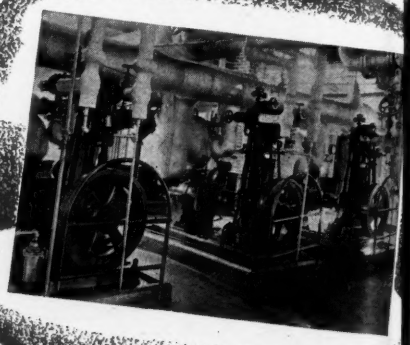




HUNDREDS of links have been forged in the making of this strong and durable chain—for in hundreds of plants you can find Troy-Engberg Steam Engines driving such power plant and processing equipment as: stokers, blowers, fans, generators, compressors, pumps, cookers, dryers and exhausters.

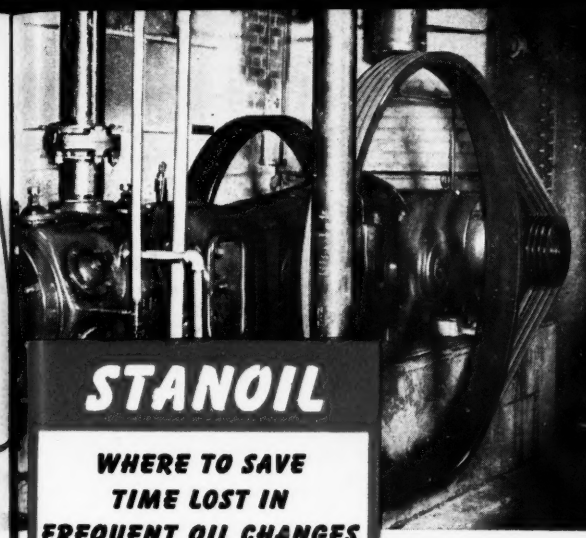
Practically all of these are "by-product power" drives—the engines in effect serving as gigantic reducing valves; taking live steam from the boilers and delivering heat units in the exhaust for processing or heating. The power taken out of the steam by the engine is rightly called "by-product power".

"By-product power" is usually much cheaper than purchased power, often so much cheaper that the entire cost of the engine is paid for in a few months or at the most, a year or two. Every plant with the need for steam for processing or heating should look into the merits of the Troy-Engberg Steam Engine as the replacement drive for those now in service and wearing out. It has much to offer.



TROY ENGINE & MACHINE CO.

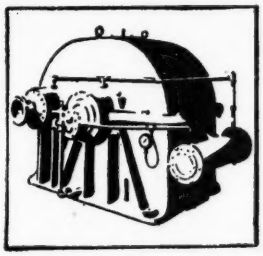
848 Richmond Ave., Troy, Pa.



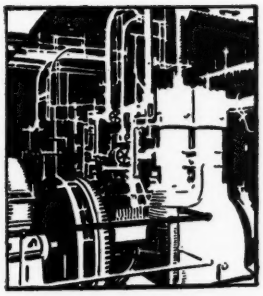
HOW TO GET MORE PRODUCTIVE TIME FROM MACHINES

STANOIL

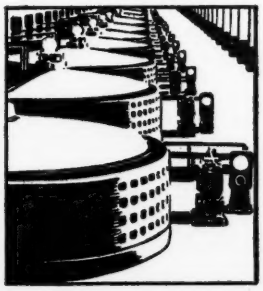
WHERE TO SAVE TIME LOST IN FREQUENT OIL CHANGES



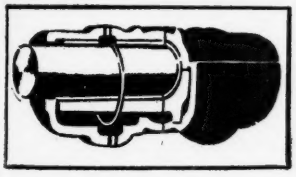
SPEED REDUCER



REFRIGERATING COMPRESSOR



HYDRAULIC TURBINE



RING-OILED BEARING

. . . LESS "TIME OUT" FOR CHANGING OIL

FIGURE the machine time lost and man hours of labor required to change oil in a gear case, circulating system, or compressor. Multiply this by all equipment of this type in your plant. Add the time required to clean many of these units. You'll find the lost productive time well worth trying to save. Here's what you can do:

MAKE THIS THE FIRST STEP

Make a test of Stanoil in just a single unit. Pick one of the harder jobs to lubricate—one where oil replacements are made most frequently. See if you don't get the same results as many other plants, where Stanoil has cut oil replacements one-half to one-third and even more on the tougher jobs. It has eliminated cleaning entirely on some systems. For instance—

HERE'S A TYPICAL APPLICATION

A new compressor in a Michigan machine tool plant had operated only two weeks when the conventional oil in use oxidized and turned black. The machine was operated almost continuously. Time out for cleaning the oil system could not be spared. Neither could the labor required for making the oil changes. A fill of Stanoil was put into the compressor. Now, oil is changed every three months instead of every two weeks. No cleaning is needed. As a result of this test all hydraulic and circulating systems in this plant are using Stanoil.

A LUBRICATION ENGINEER WILL HELP YOU

You pick the job for a test. A Standard Lubrication Engineer will recommend the grade of Stanoil needed. It won't be long before you'll notice how Stanoil keeps its color and reduces deposits. Just write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois, for a Lubrication Engineer to help you make the test.

OIL IS AMMUNITION . . . USE IT WISELY

STANDARD OIL COMPANY (INDIANA)

BRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENG

•LUBRICATION ENGINEERING•••LUBRICATION ENGINEERING•••LUBRICATION ENGINEERING•••LUBRICATION E

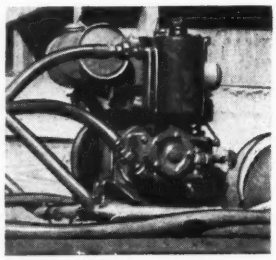
TO HELP YOU SOLVE UNUSUAL LUBRICATING PROBLEMS

FREQUENTLY, features of design in a machine raise difficult problems in lubrication. There is a simple way to solve them. Here are two examples:

EQUIPMENT A manufacturer developed a labor-saving electric concrete tamper using a three-phase induction motor with an off-balance weight on the rotor shaft to provide a vibrating motion. The motor operates at 3600 to 5000 r.p.m. The undamped amplitude of the vibrator unit is about one-fourth of an inch.

PROBLEM The motor rotor is supported by ball bearings. The lower bearing takes about 85% of the load. It was difficult to keep grease in this bearing and it had a very short life if not properly lubricated.

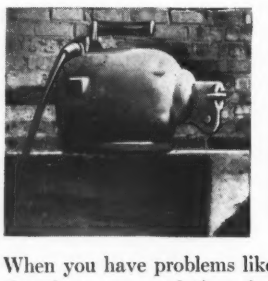
RESULT A number of brands of grease were tested. Some of them lasted but a few days. Superla 4X was recommended by a Standard Oil Engineer. It did the job. From the moment it was used, the bearings needed greasing only every two to four weeks. Superla gave good lubrication, without separating or caking. (Superla Grease No. 3X is better in cooler climates.)



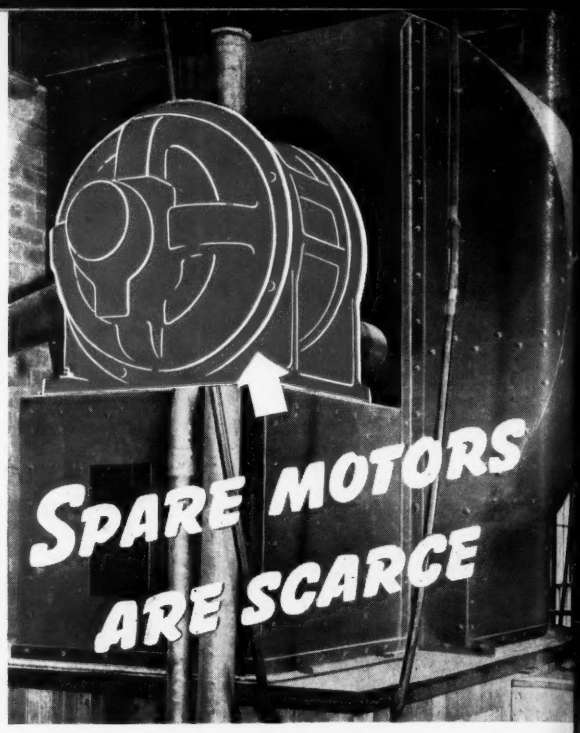
EQUIPMENT This same company makes a "Hydro-Spade" containing a hydraulically operated internal-type concrete vibrator. This consists of a vane-type hydraulic motor operating at 7,000 r.p.m., and a gear pump supplying 27 gallons of oil per minute to a motor at 160 lbs. per square inch pressure.

PROBLEM The motor must maintain a constant speed. As this unit is operated in all climates, the hydraulic oil used must not thicken at low temperatures and slow down the motor or thin out excessively at high temperatures.

RESULT Indoil No. 7 was one of the many oils tested. The viscosity characteristics and low pour point of Indoil met all requirements. The manufacturer has made Indoil available to all his customers to make sure they get the most efficient operation of the equipment.



When you have problems like these, solve them by getting the recommendation of a Standard Lubrication Engineer. Test the products he suggests. You'll save time and perhaps avoid the expense of developing special lubricants by getting the results you want from one of the wide range of standardized lubricants Standard Oil offers.



KEEP MOTORS ON THE JOB WITH STANODRIP

Do you have certain motors in your plant that are always in trouble—bearings that overheat—windings that become oil soaked—motors that require constant watching and frequent cleaning?

When spare motors and time were plentiful you could take these trouble-makers off the job and try to correct their faults. But there's neither time nor motors to spare today. Yet that doesn't mean that you have to nurse these troubles along for the duration.

Here's what you do. Where you have a motor that seems to be using a lot of oil, or where oil is creeping along the shaft and getting into the windings, test Stanodrip on it. It's designed for just such hard-to-lubricate jobs. Here's an example:

The motor on the blower pictured above was being oiled twice a week, it required frequent cleaning, and was overheated continuously. After a thorough cleaning Stanodrip No. 39 was put in the bearings. Now, oil cups are filled once every three or four weeks. Dirty windings are practically eliminated, reducing maintenance cost by about 50% on this motor. Best of all, the operator has quit worrying about failures from overheating.

Have a Standard Lubrication Engineer choose the grade of Stanodrip you need for the job you pick.

HERE'S WHERE YOU'LL FIND A STANDARD OIL ENGINEER

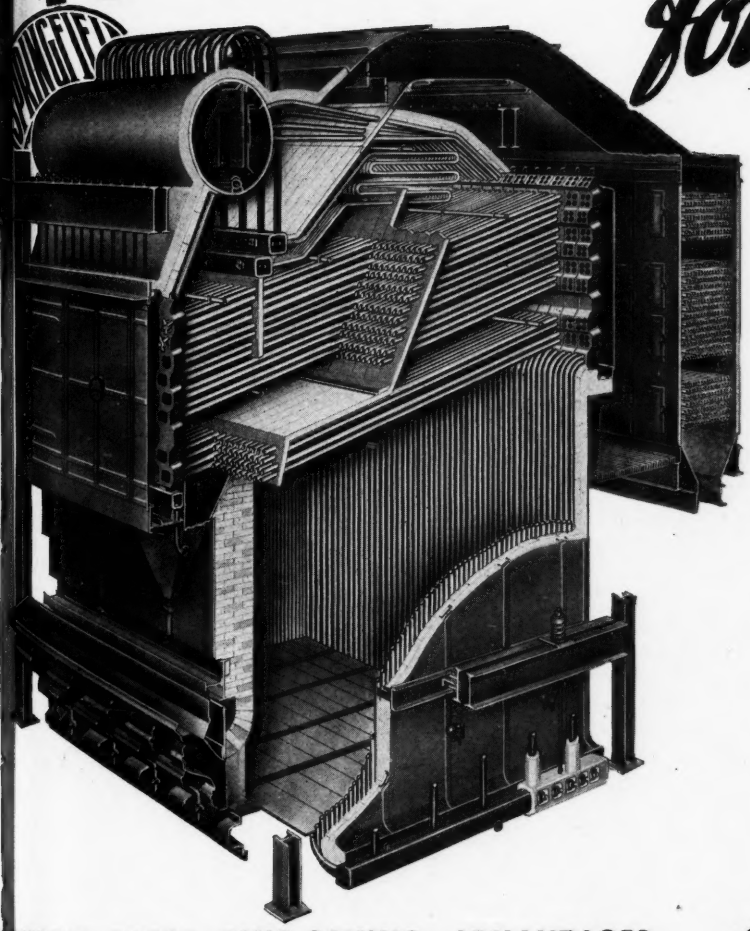
Call any local Standard Oil Company (Indiana) office in the middle western states listed below, or write 910 South Michigan Avenue, Chicago, Illinois. In Nebraska, write Standard Oil Company of Nebraska at Omaha.

COLORADO • ILLINOIS • INDIANA • IOWA • KANSAS • MICHIGAN
MINNESOTA • MISSOURI • MONTANA • NORTH DAKOTA
SOUTH DAKOTA • WISCONSIN • WYOMING

OIL IS AMMUNITION...USE IT WISELY

STANDARD OIL COMPANY (INDIAN

NOW is the time TO THINK ABOUT BOILERS for Next Winter



THE "straw that breaks the camel's back" in many a plant may be winter heating demands on already overloaded boilers. If this is your situation, or if you need new boiler capacity for any other reasons, you'll be in a better position to solve the problem if you'll lay your plans just as early as possible.

Springfield is in excellent position to help you plan your requirements and get your boilers to you with a minimum of delay. Springfield boiler design permits faster fabrication and faster erection. The Springfield shop is capable of handling the most special requirements or complete drawings, patterns, etc., are on hand to produce duplicate units of many of the modern Springfield generating units built in recent years. Write today for further facts on the quickest way to get the boiler capacity you need. SPRINGFIELD BOILER COMPANY, 1951 E. Capitol Ave., Springfield, Ill.

CHECK THESE TIME-SAVING ADVANTAGES OF SPRINGFIELD BOILER DESIGN

INGLE DRUM—requires less hard-to-get steel plate than multiple drum designs.

ECTIONAL CONSTRUCTION—tubes, headers and baffles shop-assembled nd shipped as complete header sections to save 30 to 60 days field onstruction time.

TRAIGHT TUBES—less shop time for bending.

EWER TUBE SIZES—less delay getting materials.

INIMUM DELAY IN EVENT OF DRUM STEEL SHORTAGE—Even if steel plate or drum is delayed, the rest of the job can go in and 90% of installation completed before drum arrives.

ATTENTION SPRINGFIELD BOILER USERS: NEED MORE STEAM?
IF YOU NEED MORE STEAM, WATER WALLS ADDED TO YOUR PRESENT BOILERS TOGETHER WITH OTHER NECESSARY CHANGES MAY SOLVE YOUR PROBLEM. WRITE US FOR DETAILS.

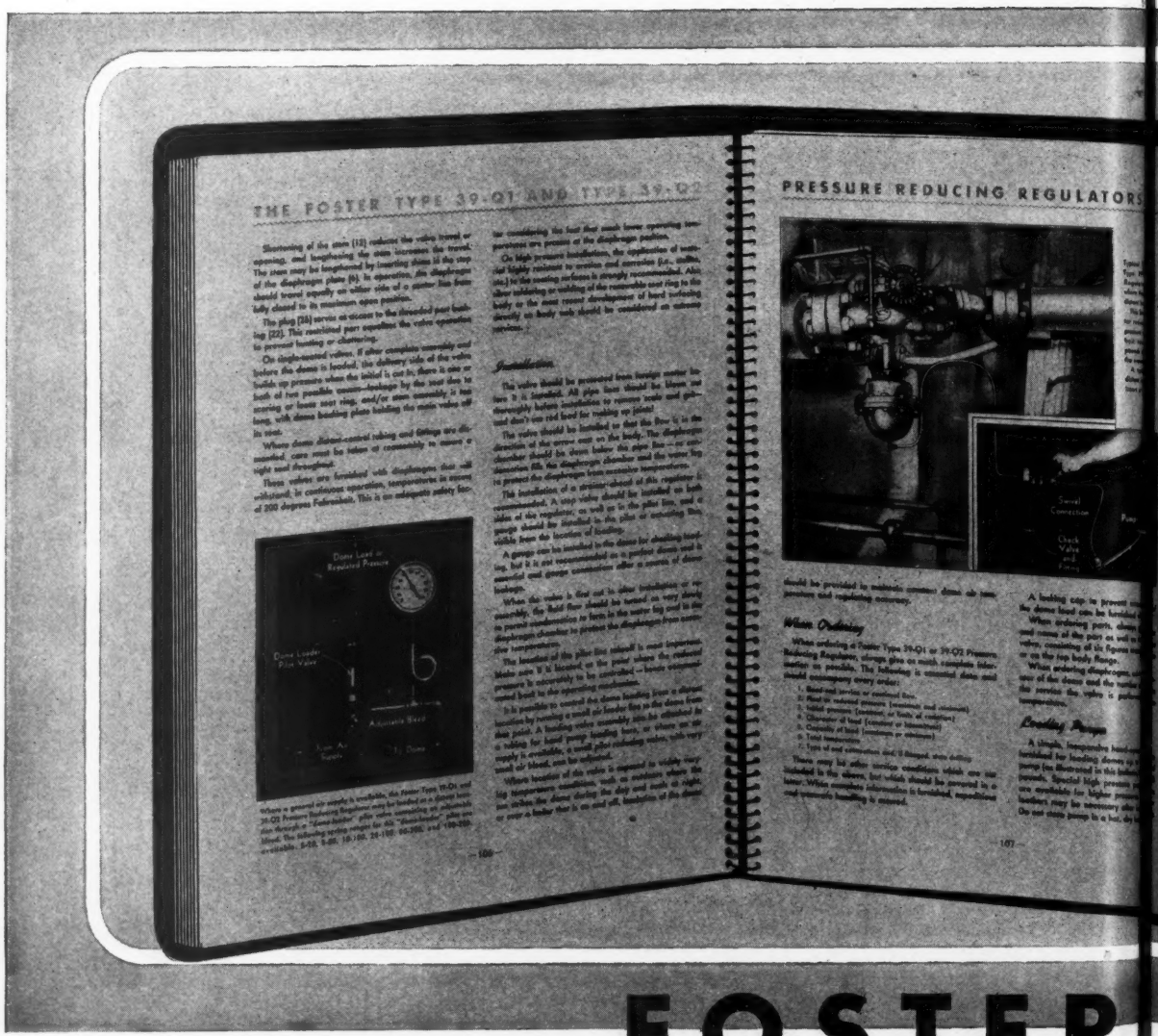
SPRINGFIELD

STEAM GENERATING UNITS

SPRINGFIELD BOILERS

ANY SIZE ANY FUEL ANY PRESSURE

ALL *of the* FACTS *on a* COMPLETE *line of* BETTER



FOSTER

Automatic Valves are contained in this NEW CATALOG!

Foster Products

PRESSURE REDUCING REGULATORS
TEMPERATURE REGULATORS
PUMP GOVERNORS
BACK PRESSURE VALVES
RELIEF VALVES
SAFETY VALVES
SIRENS
FAN ENGINE REGULATORS
DAMPER REGULATORS
AUTOMATIC STOP AND CHECK VALVES
NON-RETURN AND TRIPLE DUTY VALVES
FLOAT AND LEVER BALANCED VALVES
ALTITUDE VALVES
LIQUID LEVEL CONTROLLERS
VACUUM REGULATORS OR BREAKERS
SIGHT FLOW BOXES
STRAINERS

Here is a catalog that should interest every executive, every engineer concerned with automatic regulation or control of steam, liquids, or gases, for it contains *useful* information—*all* of the *facts*—on one of the most *complete* lines of *better* automatic valves.

And—by *"all of the facts"* we do not mean a mere *sales* story. Such sections as those on application, features, installation, and inspection—plus *eight* sections of here-to-fore unpublished engineering data—make this catalog a valuable handbook of *practical* information.

If you are pushing your plant in an all-out for victory—if you must keep your automatic valves on the firing line of the battle of production, then send for your copy of this catalog. There is no cost, no obligation—simply ask for Catalog 70; on your company's letterhead, please.

FOSTER ENGINEERING Company

111 MONROE STREET, NEWARK, N. J.

1-FE-2

Scovill Tube News

Vol. 1 SCOVILL MANUFACTURING COMPANY, Waterbury, Conn. No. 1

Factors Affecting War-Time Efficiency of Condenser and Heat Exchanger Tubes

Introduction

The widespread use of copper and copper alloys in heat exchanging equipment is due in some measure to the many favorable physical properties of these materials, i.e., their ductility, toughness, strength, high thermal conductivity, etc., over a wide range of temperatures and pressures. The excellent corrosion-resistance of the copper alloys under most operating conditions, however, is of major importance in this application. The ability of copper and its alloys to withstand the corrosive action of such media as fresh and salt waters, sewage, hydrogen sulphide, acids, alkalis, etc., is of a high order and has established their value in tube form in contact with corrosive media. They have proved their dependability and economy under such conditions as well as under wide fluctuations of temperature, pressure and velocity of the circulating media.

Serious corrosion of condenser and heat exchanger tube does occur, however, particularly when corrosive conditions are admittedly very severe and such corrosion may result in considerable expense, costly delays and shut-down of equipment. In many cases, no improvement in tube life can be expected under existing conditions; in other cases, however, it has been possible to reduce or retard corrosion materially and obtain improved tube performance either by slight changes in operating conditions, by attention to certain operating details or by a change from one tube alloy to another which is more corrosion-resistant to the particular service conditions. For this reason, an appreciation of the factors which contribute to corrosion of tube materials is often of value to a better understanding of corrosion problems; this knowledge, in turn may be used to advantage in combatting such problems and in improving tube life. The subject is considered of sufficient importance to tube users to warrant discussion of the more important matters pertaining to corrosion problems.

Limitation Order L-154 issued by the O.P.M.
This order limits the use of non-ferrous condenser tubes in land power stations to Muntz metal for fresh water plants and Admiralty metal for salt water plants. No non-ferrous metals containing more copper and more tin than these two are permitted by the order.

New War-Information Service to Save Scarce Tube Metals

First in a continuing series of informative bulletins on condenser and heat-exchanger tubes, the article on this page is part of Scovill's Service in Manuals available without charge to all tube users. Reprints of each numbered article are available on request and will form a new, complete "Condenser Tube Booklet" including conditions of service, types of corrosion, and selection of materials. Write Scovill Manufacturing Company, 17 Mill Street, Waterbury, Conn.

Factors Affecting Tube Life

The service life of condenser and heat exchanger tubes is governed by the following major influences:

1. the composition of the alloy
2. the workmanship and quality of the tubes
3. the conditions of service of the tubes

The most satisfactory tube service and tube performance in a heat exchanger unit is obtained only after a careful consideration of these factors. Some discussion is therefore devoted to each of them.

1. The Composition of the Alloy

The non-ferrous alloys for heat exchanger service may be grouped into three broad classifications, as follows:

(a) Copper, Phosphorized Copper and Arsenical Copper

(b) Brasses or Copper Zinc alloys, usually containing small percentages of other metals such as Tin, Aluminum, Nickel, Iron, Lead, etc.

(c) Copper Nickel alloys, containing Copper, Nickel and, in some cases, minor amounts of other elements such as Tin, Iron, Manganese, Zinc, etc.

Most of the tube alloys carry trade names which usually identify them, as for example, muntz metal, naval brass, admiralty metal, red brass, aluminum brass, etc. The choice of any particular alloy for a particular service is based on the known behavior of such alloys under any definite set of conditions, on previous service experience of tubes in the unit in question or similarly operated units, and on the type or form of corrosion which predominates. It may be pointed out, by way of illustration, that copper and alloys of high copper content (85% or over) are not generally recommended for service where corrosion by hydrogen sulphide or similar sulphur compounds is known to be severe; likewise, muntz metal and other alloys of brass high in zinc content (which contain no inhibitive agent) are not serviceable under conditions where serious dezincification may be experienced. On the other hand, tubes of aluminum brass or copper-nickel withstand mechanical abrasion or erosion-corrosion better than other alloys.

This subject is further discussed in a later issue of "Tube News".

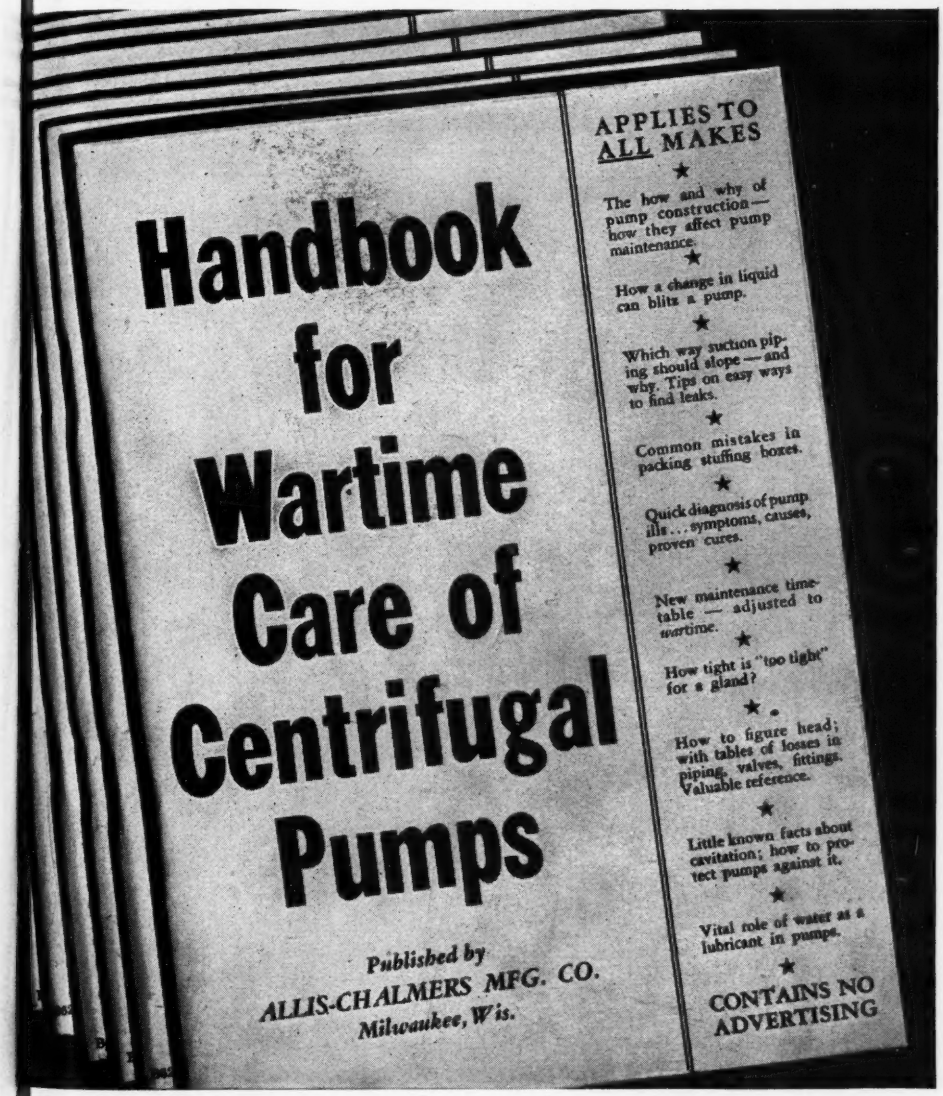
Scovill MANUFACTURING COMPANY WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

Fresh Off the Press!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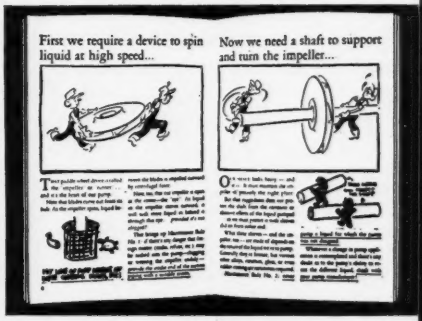

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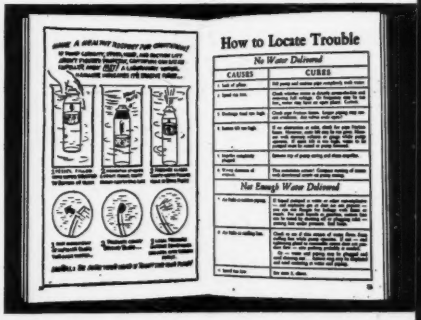

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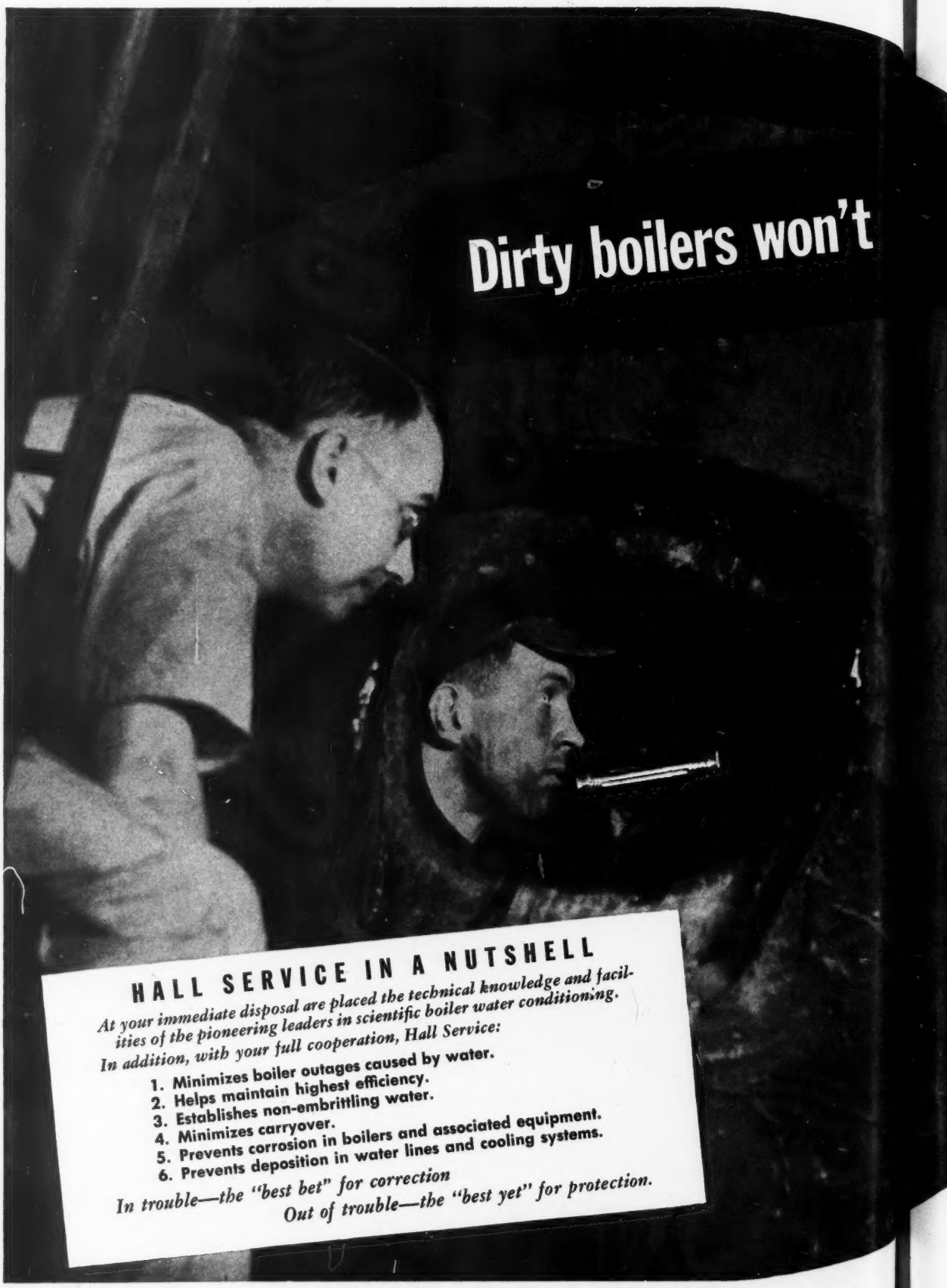
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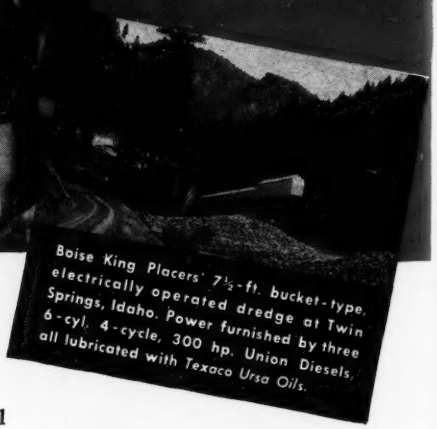

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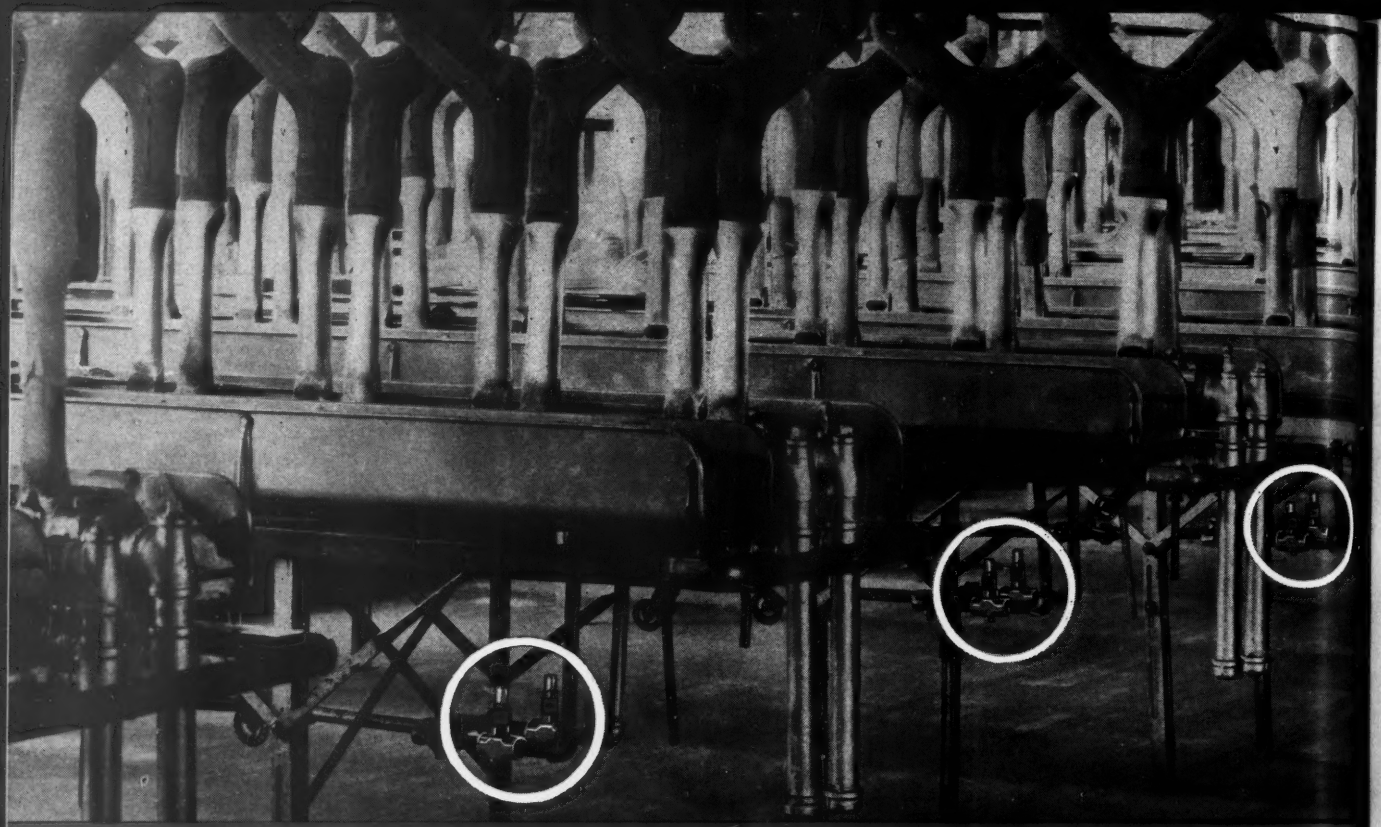

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WHAT LEADERS SAY

Lasting Value In War Science Effort

By DR. WM. D. COOLIDGE

TODAY we see the majority of the scientists of the world, both university and industrial alike, recruited for use in war, and we see science playing so vital a role that it may win or lose the struggle.

While the necessity for the scientific effort involved represents in magnitude the greatest tragedy which civilization has ever encountered, much of it will have lasting value, and in many important lines research is being prosecuted at a rate which would be quite out of the question in peacetime. This is especially true in the fields of physics and chemistry.

In the X-ray field until within the last year and a half, few radiographs had ever been made using more than a couple of hundred thousand volts. As a result of the war, industry is now employing many one-million-volt radiographic outfits. These are portable and mechanically and electrically flexible and permit the ready examination of steel castings and welds up to a thickness of as much as 8 in.

There also has been built an induction electron accelerator for 20 million volts and we are now building a larger one designed to operate at voltages up to 100 million. This machine, used as a source of X-rays, should enable us to determine what radiographic and other useful results can be accomplished by such high-voltage radiation.

This same device should also render available for physical, chemical and medical experimentation cathode rays corresponding to these same enormous voltages. In the medical field these cathode rays may have a good deal of therapeutic interest in the treatment of deep-seated tumors since they will have sufficient penetration and, unlike X-rays and gamma rays, their effect will be a maximum near the end of their range-properties which should facilitate the destruction of a tumor without damage to the overlying tissues.

During this war we have seen an X-ray development take place which will have great permanent value. It consists in the photography with the camera of the fluorescent screen image and, in the case of chest examinations, it will reduce the cost of the photographic film required to about one-tenth that of the usual direct method of radiography and with but little sacrifice in diagnostic value. This will make economically possible the chest radiography of all army recruits and the frequent chest examinations which are so desirable in the case of young people.

The fluoroscopic application of X-rays is also being developed rapidly for use in industry where it makes possible the ready examination of small metal castings. Without this nondestructive method it has sometimes been necessary to expend much machine work on a casting before a fatal hidden defect was revealed. Such wastefulness of labor is now avoided by the fluoroscopic inspection.

A tremendous contribution to this war effort is being made by our colleges not only through the activity of their scientific staffs in developing important new materials and new devices but also through the use of their teaching facilities. The importance of this last can hardly be over-estimated, for we must not only have the necessary new mechanisms of warfare but we must also have an adequate number of people conversant with their use and their maintenance, and the essential basic training for these people is best given in the colleges.

While Roentgen, Faraday and Henry were honored for their discoveries, the fact remains that the institutions which they attended attracted them and they were perhaps unconsciously inspired by their traditions.

Science institutions bring their votaries together and thus facilitate cooperative effort. The science laboratory and the scientific society alike facilitate the helpful interchange of ideas. Some individuals are by preference lone workers, but fortunately for human progress the scientist is usually a gregarious animal.

The question is sometimes asked as to whether the day of the lone scientific worker is past. While the answer is 'No,' it is certain that with the great increase which has taken place in recent years in the number of science laboratories and in the number of people working in them, the percentage of our scientific progress due to the lone worker has undergone a corresponding decrease.

DR. WILLIAM DAVID COOLIDGE, vice-president and Director of Research of the General Electric Co., was born on October 23, 1873, at Hudson, Mass. He was graduated from the Massachusetts Institute of Technology in 1896 with a B.S. degree in electrical engineering. In 1899 he received his Ph. D. degree from the University of Leipzig, Germany, where he had been granted a scholarship to study physics. After his return to the United States, he went back to M.I.T. where he became assistant professor of physico-chemical research.

In 1905, he accepted the invitation of Dr. Willis R. Whitney, Director of Research at the General Electric Laboratory and a former colleague at M.I.T., to come to General Electric to carry on his research there. In 1908 Coolidge was made Assistant Director of the Laboratory. In 1940 he became vice-president of the General Electric Co. and succeeded Dr. Whitney as Director of Research.

Dr. Coolidge discovered that tungsten is rendered ductile at high temperatures, a discovery which revolutionized the lighting industry and made possible a cheaper, stronger, better incandescent lamp. Experiment with this discovery led to his improvements in the X-ray tube and later to the development of a new type of X-ray tube which could be controlled, therefore lessening the danger of burns. During World War I, Dr. Coolidge's experiments with the Broca tube, used to detect and locate submarines, led to the development of the "C" tube which eliminated noises that had marred the effectiveness of the Broca tube. The later "K" tube further eliminated water noises. He also developed the portable X-ray generating outfit for use in field hospitals. The material presented on this page is from a speech made by Dr. Coolidge at Ursinus College, Collegeville, Pa., on Founder's Day when a new science building, the Pfahler Hall of Science, was dedicated.

The

Looking down on the new 4,000,000 v. direct current X-ray generator developed at the Massachusetts Institute of Technology for medical research. This photograph shows the generator structure of laminated metal rings capped by a high-voltage terminal as it appears without the pressure tank in which it is ordinarily enclosed. Close by are the polished voltage dividing shields which are placed over the column assembly. These shields in effect separate the generator into three independent units, one within another. The vertical X-ray tube located in the center of the generator projects into a treatment room below. ¶ The generator has produced for the first time radiation more penetrating than the gamma rays of radium and with an intensity greater than that of the entire available world supply of radium. It is already being used in experimental clinical treatments. The generator, the design of which is based on the Van de Graaff type of electrostatic high-voltage machine, is 13 ft. high, and is insulated by a mixture of compressed air and Freon gas in a sealed tank. It has been operated at voltages up to 4700 kv.—almost 5,000,000 v. In operation, negative electric charge is sprayed on the insulating belt at its lower end and hauled up into the high voltage terminal, which acquires a negative potential relative to ground in direct proportion to the electric charge stored on the large metal sphere

Shape of Things to Come

IN A WORLD torn and disrupted by war it is difficult to look forward to another new year in the traditional way. It has always been the custom at this time of the year to stop and take account of ourselves, to measure our accomplishments, to evaluate our successes and failures and to make, if not to keep, resolutions as to our conduct during the coming year. This year, with widespread anxiety and suffering all over the world, it seems ironic to speak of progress in any sense for in the ultimate analysis the only progress that means anything is that which can be measured in terms of human happiness. Today we are at war, and war is the very antithesis of social progress; instead of happiness it breeds misery, frustration and despair. No sane person can condone war on any grounds.

Yet, despite war, the world moves forward. In some strange way war teaches us—teaches us not only the error of our ways but fills us with a new sense of our capabilities. Phoenix-like, mankind has the habit of rising from its own ashes to attain greater heights and achievements. It is possible though not very probable that this war might have been averted but if it had it is quite evident that certain advances in human understanding and in material progress which this war is bringing about, would have been delayed many years. In many ways the war represents an accelerated movement of a process which has been in progress since man first learned to use mechanical power.

We emerged from the first World War with certain new concepts and achievements. The rapid development of radio and the airplane both can be attributed to the first World War and it also gave us our first concept of the significance of mass production. Above that, on the social side, it gave us Americans a concept, however inadequate, of our position in the world with respect to other peoples. True, the League of Nations failed, not so much because we were not in sympathy with its ideals but probably because in the nature of things it represented too great a step for mankind to take at one time. Despite the fact that we were living in a 5, 10, or 15 hp. per capita world our thinking was still geared largely to a ¼ hp. per capita mental outlook.

This war can be attributed to many things; to the desire for power on the part of individuals, to unbalanced economic conditions, to misunderstandings between peoples and nations, etc., but, fundamentally the roots of the war lie deep in the misunderstanding of the proper use of mechanical and electrical power with respect to social development.

The great increase in the availability of power has not only brought all the peoples of the earth closer together but it has enabled many more people to live on this earth. A century ago there were approximately a billion people in the world. Today, in 1943, the world population is estimated to be some 2½ billion.

This increase in world population, coupled with the increase in the development of transportation and communication, inevitably resulted in friction. The advent of the machine brought with it certain evils. Its labor-saving capabilities were not used so much to save labor as to increase production for the benefit of a few at the expense of the many.

The introduction of the machine did not bring universal happiness; for many it brought the opposite; to large masses it brought exploitation, poverty, unemployment and industrial depression. As pointed out by Henry George over 60 yr. ago, though the march of invention clothed mankind with powers which a century before the boldest imagination could not have dreamed of, the material progress tended in no way to improve the condition of the lowest classes in the essentials of healthy, happy human life. The new forces, he pointed out, did not act upon the social fabric from underneath as was for a long time hoped but struck at a point intermediate between top and bottom. It was as though a wedge was driven into the structure of society. Those who were above the point of separation were elevated, but those who were below were crushed down. Henry George has been dead many years but the fundamental truths he enunciated are at least in part responsible for the present world conflict.

Today we are again at war, and already our world of 1940 in which we took such pardonable if mistaken pride, seems almost an antiquity when regarded from the standpoint of science and engineering. The pressures of this war are compressing into the space of months developments that might have taken us half a century to achieve if necessity had not set the pace. The most uninformed among us hears something of the tremendous things that are going on in the laboratories and in the manufacturing plants of the world.

Plastics, electronics, synthetic materials of all kinds, we hear, are going to revolutionize living. We are extracting vital and wonderful metals from the waters of the ocean, the aluminum production of this country is such that in a single year it could furnish enough aluminum to construct three times the number of passenger cars operating on the American railroads. We are making electric generators for airplanes weighing 42 lb. which produce as much power as several dozen standard 23-lb. automobile generators. With the manufacturing capacity now being added, the aviation industry will soon be able to make in one year almost twice as many planes as the country produced during the entire 37 yr. of aviation history.

In the field of petroleum chemistry wonders undreamed of a few decades ago are becoming realities. The largest catalytic cracking capacity in the world is being operated by American oil companies. The significance of this development which will approximate hundreds of thousands of barrels daily is beyond all present vision. It will form the basis not only for explosives and synthetic rubbers but for plastics, dyes, drugs and a thousand other products.

A short half-century ago Mme. Curie discovered radium and since then its radiations have been the only control man has had in the treatment of cancer. On the opposite page is shown a view of a new X-ray generator, rated at 4,000,000 v. and which has produced for the first time radiations more penetrating than the gamma rays of radium and with an intensity greater than that of all the radium in the world.

These are some of the things that are going on in the world. Just now, they are all geared to the war effort, but they will remain to serve mankind in countless ways after the war is over.

If these material developments were the only developments being accelerated by the war, they would brighten the present dark period but little. In themselves they could add little to human happiness. But while the material developments are taking place, progress of another kind also is being made. This is the progress in our thinking, in the desire for a better post-war world.

The intent of the Atlantic Charter is good; it holds forth an element of hope for all the oppressed and exploited peoples of the earth. Movements in England point to a post-war nation with a system of social control such that none will be rich but which will offer a measure of comfort and security, hence happiness, to every person in the land. Profound changes in social attitudes are taking place. The Reports of The London Chamber of Commerce and the Association of British Chambers of Commerce is almost shocking in its implications. It reads more like a socialist indictment of capitalism; it criticizes the anachronisms of finance, the international struggle for markets, the fallacy of poverty amidst plenty and a lot of other things.

In this country, industrialists, intent as they may be in preserving the traditional system of so-called free enterprise, are broadening their social outlook to an extent undreamed of a decade ago. A most encouraging aspect about their thinking in their increasing recognition of the problem of unemployment. They are beginning to see that unemployment is as detrimental to their own interests as it is to the workers, and in their various proposals, unemployment is being regarded from the social side rather than the financial side as heretofore.

It cannot be assumed that because this sort of thinking is going on that all these plans will materialize or that the world's troubles will disappear after the war. In many ways our troubles will only begin, but we will have a new world to work in, a world in which, from a material standpoint, nothing will be impossible, and man's highest hopes will have a chance of achieving realization.

Extension to Cape Fear S

Twenty-year-old central station of the Carolina Power & Light Company given an almost 200 per cent increase in capacity by the installation of two 31,250 kw. generating units

By W. F. FRIEND
Mechanical Engineer, Ebasco Services, Inc.

THE EXTENSION of Cape Fear Station, now under construction, will add 60,000 kw. to present dependable capacity of station, now about 35,000 kw. Company system is predominantly hydroelectric and is interconnected with neighboring utilities and large industrials in South Atlantic states. Orders for the two turbine generators were placed early in 1941; trial operation of first unit is under way, and second unit is expected to be ready at an early date.

Condensing water is obtained directly from the river. Fuel is West Virginia bituminous, now carrying delivered price about $0.20 per million B.t.u.; in future, coal might come from a nearby field. Plant output goes entirely into 110-kv. transmission system.

The extension comprises two turbine generators each having nameplate rating 31,250 kw. at 0.87 p.f., with hydrogen cooling at 15 psi. There are two steam generating units, arranged for pulverized coal firing by unit system. Steam conditions are 850 psi 900 deg. F. at throttle. The heat cycle is standard regenerative, using four extraction points. Performance estimated is 11,700 B.t.u. per kw-hr. net output at full load, with 2.0 in. Hg back pressure and overall boiler-unit efficiency 87 per cent.

Incorporated in the design is semi-outdoor type of boiler installation, which has been applied successfully during the past decade in more than a dozen installations aggregating not far from one-third million kilowatts of capacity. These plants are situated in regions where winter climate ranges from temperate to severe, namely, from Florida to Texas to Nebraska and Utah.

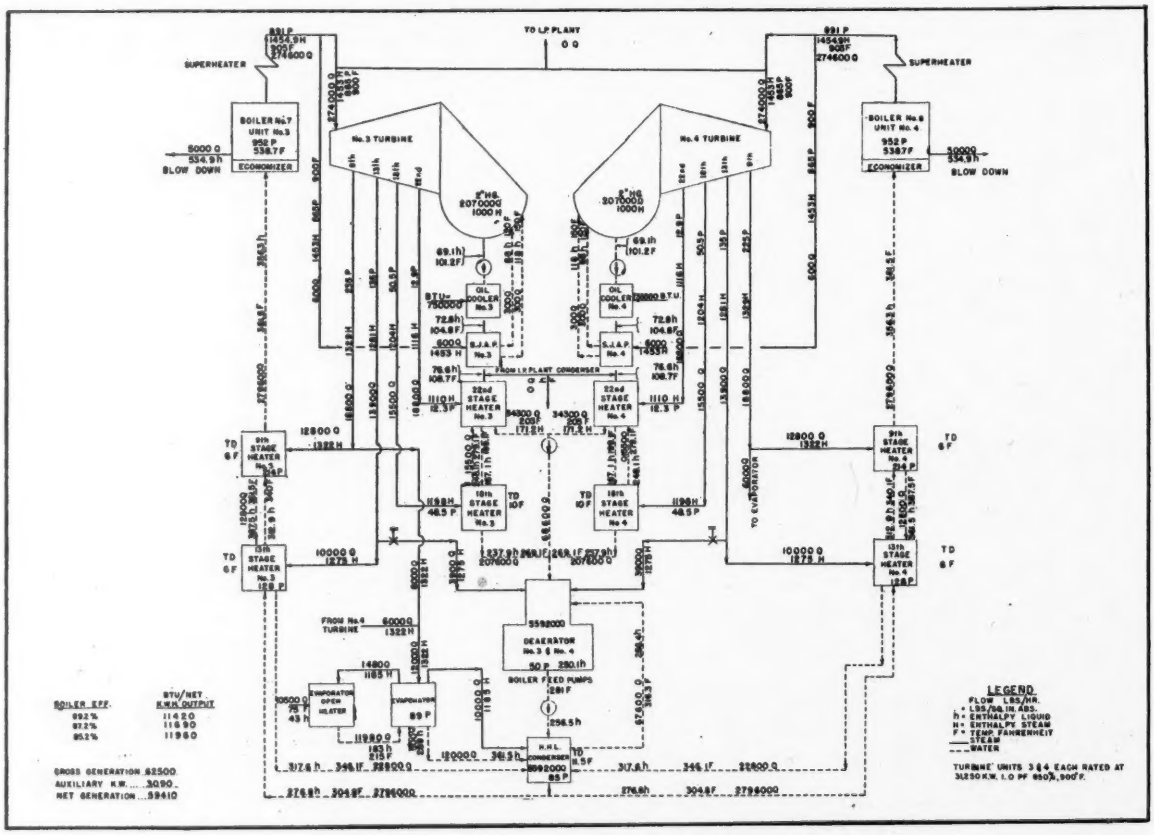

Fig. 1. Heat balance diagram for the two new units at Cape Fear Station

Station Adds 60,000 kw.

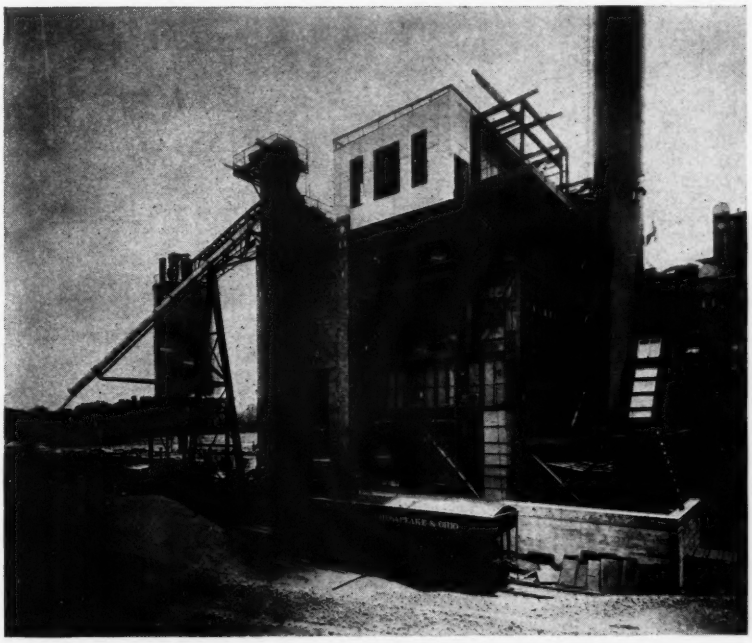

Fig. 2. This view shows the semi-outdoor type of boiler used in the new extension to Cape Fear Station. This type of construction has been applied very successfully in a number of other installations

Saving in cost by omission of usual full enclosure around boilers is substantial; still more important under wartime conditions is the conservation of steel for structural framing, and the elimination of metal in other details such as window sash.

Comfort of operators and maintenance crew is increased during most of the year by the semi-outdoor arrangement, this improvement outweighing the disadvantages in occasional recourse to tarpaulins or other temporary protection, if repair work should become necessary in inclement weather.

General Arrangement

Steam-generating units are alongside the turbine-room extension, and an auxiliary bay that accommodates the feedwater heaters, pumps and miscellaneous equipment occupies space between new units and the old boiler room. No extension of electrical bay was required.

Arrangement of building and principal equipment is indicated by plan and sectional elevation in Figs. 1 and 2. Protection of upper boiler drums and related accessories is supplied by a housing of corrugated asbestos sheathing carried on light steel framing.

One side of new boiler No. 8 and rear of both the new boilers are left exposed, the casing panels for boiler settings being made weathertight. The arrangement provides enclosure for bunker, pulverizers and the firing aisle—where equipment and its operating staff might be adversely affected if exposed in cold or wet weather.

Draft fans are accommodated in basement beneath boilers, utilizing space that resulted from adherence to operating floor levels of original station.

Condensing-water improvements include addition of one bay for stationary and revolving screens, on present two-bay intake structure, which is connected to concrete tunnel extending under station building. For discharge from condensers there has been constructed a canal taking water downstream into river. Gates at end of building and at outlet end of canal permit use of existing discharge tunnel directly to river, when river flow is sufficient to prevent recirculation or when canal requires maintenance work.

Coal Handling, Preparation and Firing

Coal equipment includes 80-ton track hopper, two 75-ton per hr. bucket elevators, a single 75-ton per hr. crusher, and spreader conveyors delivering to bunker above firing aisle. Existing storage yard equipped with drag scraper serves new extension. Ash disposal is by steam-operated pneumatic system discharging to new 250-ton overhead storage tank arranged for dumping into railroad cars or trucks.

Pulverizers are Riley unit type, three per boiler, each rated 15,000 lb. per hr., delivering to six Riley flare-type forced draft burners per furnace.

Boiler Units and Auxiliaries

There are two Riley steam-generating units, each rated 330,000 lb. per hr. maximum continuous, of the 3-drum bent-tube type with 11,060 sq. ft. heating surface. Furnaces of dry-bottom design have water walls aggregating 10,590 sq. ft. heating surface, and volume 16,600 cu. ft.; heat in the fuel fired is thus 25,000 B.t.u. per hr. per cu. ft. at rated maximum output. Superheaters are interdeck with hand-operated temperature-control damper in setting. Heat traps comprise 7220-sq. ft. loop-type economizers and 36,000-sq. ft. tubular airheaters.

Boiler plant auxiliaries include five boiler feed pumps (one steam four motor) each rated 185,000 lb. per hr., closed extraction heaters for the four bleed points per turbine, and single evaporator with make-up heater and condenser for the two units jointly. Steam piping is of simple unit design, the lead from each boiler and its turbine connecting into a short manifold, with cross-tie between the two manifolds. No connection is made to existing 310 psi 600 deg. F. system, but an

CAROLINA POWER & LIGHT CO., CAPE FEAR STEAM ELECTRIC STATION

Turbogenerators—two Westinghouse, rated at 31,250 kw. 0.87 p.f. with hydrogen cooling at 15 psi, 13.8 kv. 3600 r.p.m., including direct-connected exciter.

Surface condensers—two Lummus two-pass divided water box type, 26,500 sq. ft. (including 1300 sq. ft. internal air cooler), rated 215 million B.t.u. per hr., with auxiliaries.

Traveling water screen—one Link Belt model E-6, with 3-hp. enclosed motor.

Service-water chlorinating equipment—two Wallace & Tiernan solution-feed vacuum semi-automatic type, rated 12 lb. chlorine per 24 hr.

Steam generating units—two Riley bent-tube type for 900 psi 905 deg. F., rated 330,000 lb. per hr. continuous, comprising:

	Heating Surface, Sq. Ft.
Boiler	11,060
Water walls	10,590
Superheater, with manual bypass damper	
Economizer, continuous loop counter-flow	7220
Air heater, tubular single-pass	36,000

Pulverized-coal equipment—six Riley Atrita unit pulverizers with exhauster fans, also twelve Riley flare-type burners.

Forced-draft fans—two Sturtevant turbovane design No. 9, double width, double inlet, vane control, with 200-hp. squirrel-cage motors.

Induced-draft fans—four American Blower No. 7½ double width, double inlet, vane control, with 200-hp. squirrel-cage motors.

Boiler feed pumps—five Byron Jackson 8-stage double-case, rated 185,000 lb. per hr. at 281 F. and 2950 ft. total discharge head; four 450-hp. 3600-r.p.m. squirrel-cage motors; one 440-hp. Terry turbine with constant-speed governor for steam 850 psi 900 F. at throttle and 50 psi exhaust.

Deaerating heater—one Cochrane horizontal type, 10 ft. diameter by 25.5 ft. long, rated 750,000 lb. per hr., with auxiliaries.

Feedwater regulators—two Smoot boiler water-level oil-operated type, with duplicate motor-driven oil pumps.

Evaporator—one Lummus horizontal U-tube type, 467 sq. ft., rated 10,000 lb. per hr. vapor output.

High heat level condenser—two Alco U-tube type.

Water-treating equipment—one Elgin filtering and coagulating plant, including alum and soda-ash solution tanks and pressure filter.

Closed feedwater heaters (Unit No. 3)—three Alco vertical type for 9th, 13th and 22nd stage extraction steam, respectively.

Closed feedwater heater (Unit No. 3)—one Struthers-Wells vertical type, for 18th stage extraction steam.

Closed feedwater heaters (Unit No. 4)—four Struthers-Wells vertical type for 9th, 13th, 18th and 22nd stage extraction steam, respectively.

Coal-handling equipment—one Webster system, rated 75 tons per hr., including all accessories other than coal scales.

Steam locomotive—one Baldwin 40-ton, saddle-tank 4-wheel type.

Ash-handling equipment—one Nuveyor system, rated 20 tons per hr., with 250-ton storage tank.

Lubricating oil purification system—two Bowser type A filter units, with one 5000-gal. storage tank, also transfer oil pumps.

Air compressor—one Gardner 6-cylinder 2-stage, rated 315 c.f.m. at 100 psi, with 75-hp. motor.

Main control board—one General Electric complete switch-board for two turbogenerators, two 32,000-kv-a. main transformer banks, two 2500-kv-a. auxiliary power transformers, and auxiliary power supply.

Auxiliary power switchgear—two Ite 550-v. air circuit breakers, withdrawal type.

Auxiliary power load centers—eight Pelham 550-v., with Ite air circuit breakers, 10,000 amp. interrupting capacity.

Main transformers—four General Electric 16,000-kv-a. 3-phase self-cooled outdoor type, rated 55 C. rise 120/115/110/105 Y—13.2 delta kv., for future forced-air cooling to give 21,333 kv-a. at 55 C. rise.

Auxiliary power transformers—three Moloney 2500-kv-a. 3-phase self-cooled outdoor type, rated 55 C. rise 13 800/13 200/12 500 delta—575 delta volts.

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outlet is left for future pressure-and-temperature reducing station. Piping systems, including steam, boiler feed and condensate, are of all-welded construction, except at valves and equipment that require dismantling and servicing.

Induced-draft fans, two per boiler, have 200-hp. constant-speed motors. Dust separators ahead of fans are of American Blower make, specified to remove at least 85 per cent of ash in gases at 300,000 lb. per hr. steam output. Discharge from collector hoppers is to pneumatic conveyor delivering into same storage tank as used for furnace ash. One steel chimney 12 ft. diameter by 150 ft. above yard grade serves both boilers.

Generator Units

Turbogenerators of Westinghouse manufacture are of conventional design, with hydrogen cooling arranged to operate at pressures up to 15 psi gage. Service water from three 250,000-lb. per hr. pumps is supplied to hydrogen coolers, hydrogen seal coolers and spare oil cooler; main oil cooler receives condensate. Units have direct-connected main and pilot exciters.

Condensers are Lummus 26,500-sq. ft. 2-pass, each rated 215 million B.t.u. per hr., with divided water boxes, internal air cooler, single 68-c.f.s. circulating pump and dual 270,000-lb. per hr. condensate pumps. These pumps are motor driven.

In the design of the plant the unit or one-boiler-per-turbine arrangement was adopted, including provision for connection of steam and condensate lines to original (low-pressure) section of plant. The cycle is regenerative, with steam extracted at 9th and 13th turbine stages for h-p heaters on discharge side of boiler feed pumps, and from 18th and 22nd stages for l-p heaters ahead of deaerator. The latter is supplied with heating steam from 13th-stage extraction point. The single evaporator serving both units utilizes 9th-stage steam. Performance indicated, with 31,250 kw. gross generation, 5 per cent energy to station auxiliaries and 87 per cent efficiency of steam generating unit, is 11,700 B.t.u. per kw-hr. net output.

Electrical Features

Electrical facilities include direct connections made with copper tubing from each generator to its step-up bank, this comprising two self-cooled 16,000-kv-a. 13.2/115-kv. transformers. Generator neutrals are grounded through reactors. For each unit, capacitors and lightning arresters are connected to main generator leads—the capacitors being located indoors close to generator terminals and the lightning arresters outdoors near main power transformers. Main control switchboard consists of bench sections and instrument panels placed in control room, using space previously provided.

Auxiliary electrical equipment includes three outdoor self-cooled 2500-kv-a. 13,800/575-v. trans-

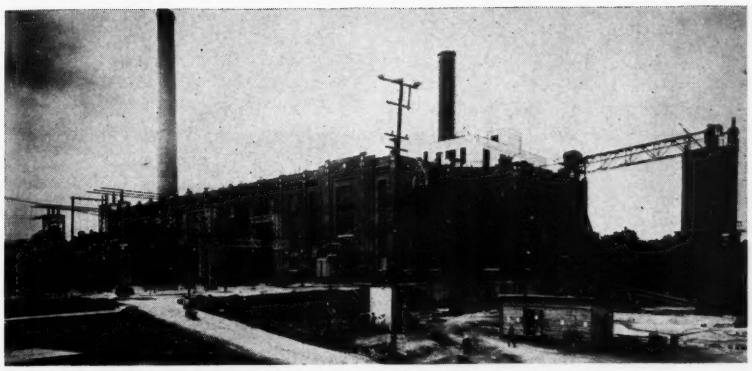


Fig. 3. A general view of the Cape Fear Station

formers; two of these are directly connected to leads of respective generators, and third is spare. Switchgear for distribution and control of auxiliary power consists of metal-clad buses and draw-out air circuit breakers. Each of the boiler-and-turbine units has two load centers for boiler auxiliaries and two for turbine-room auxiliaries.

Substation Facilities

In the step-up substation, which is of usual outdoor type, each transformer bank has steel structure 30 ft. high in bay 32.5 ft. by 20 ft., to carry transformer primary and secondary connections consisting of copper tubing mounted on post-type insulators. Provision is made for placing an existing 10,000-kv-a. spare transformer alongside each new bank, requiring foundation and water-cooling connections. By recourse to air pressure cooling on new 16,000-kv-a. transformer, when used with spare 10,000-kv-a. transformer, there will be available 31,333 kv-a. capacity in emergency. Yard area around transformers has crushed-stone fill 2.5 ft. deep, drained by perforated piping to conduct any leakage oil from transformer casing into river downstream from condensing-water intake, thereby minimizing transformer fire hazard.

For each of the two new generators is provided one 115-kv. outdoor circuit breaker equipped with potential devices to be used for synchronizing. There are also disconnecting switches and connections to high-voltage buses, similar to those for existing generators. Another 115-kv. breaker with disconnecting switches is being installed in an existing switchyard bay for new outgoing line.

The original Cape Fear Station was built commencing about 20 yr. ago, site having been chosen as reasonably central to transmission system, as convenient to railroads and transmission lines, and as possessing condensing-water facilities. It contains two turbine generators each nominally rated 15,000 kw., and has actual net output capability of 35,000 kw. Steam conditions are 310 psi gage 660 deg. F. at throttle. Boilers are fired by underfeed stokers, and three of the six boiler units have air heaters. The only other steam plant on Carolina system is located near Asheville and has 13,000 kw. net capability. Remainder of system power supply is from hydroelectric plants or is secured by purchase from neighboring utilities.

Ebasco Services, Incorporated acted as consulting and designing engineer for Carolina Power & Light Company, on the Cape Fear extension project.

EDISON MEDAL TO DR. E. H. ARMSTRONG

THE EDISON MEDAL for 1942 has been awarded by the American Institute of Electrical Engineers to Dr. Edwin Howard Armstrong, professor of electrical engineering, Columbia University, "for distinguished contributions to the art of electric communication, notably the regenerative circuit, the superheterodyne, and frequency modulation."

The medal will be presented to Dr. Armstrong during the National Technical meeting of the American Institute of Electrical Engineers to be held in the Engineering Societies Building in New York, N. Y., January 25-29, 1943.

Dr. Armstrong was born in New York City on December 18, 1890. He began his engineering studies at Columbia University and became a protege of Michael I. Pupin, Edison Medal recipient in 1920, with whom he worked closely on many important research undertakings.

While an undergraduate he became interested in the operating properties of the audion detector and set out to learn more of the principles of operation of thermionic tubes. The research that followed at his home in Yonkers, N. Y., resulted in his invention of the feedback or regenerative circuit which became the means not only of increasing the sensitivity of the audion as a detector of radio signals but also became the means of producing for the first time continuous high frequency oscillations by means of a thermionic tube. In December, 1914 he published the first scientifically correct explanation of detection and amplification in the audion detector and in March, 1915 disclosed the regenerative and oscillating circuits.

He graduated from Columbia University in 1913 with a degree of electrical engineer, and continued as an assistant in the department of electrical engineering. In 1915, he received the Trowbridge Fellowship from Columbia University.

In 1917, Dr. Armstrong entered the service of the United States Army as a Captain in the Signal Corps, and later was promoted to rank of Major. While serving in this capacity in France, he made his second invention which became destined to be another cornerstone in the development of the radio communication art. This was the superheterodyne receiving system.

This system of receiving far surpassed any development up to that time and it is still the type of circuit used today in practically all radio receivers.

The third outstanding invention was his development of the super-regenerative circuit which was disclosed in 1922. This system of radio reception provides a means of increasing the sensitivity of a detector above that normally obtained by means of simple regeneration. This receiving circuit supplied the principal means of exploring and developing the ultra short wave channels.

The fourth outstanding invention of Dr. Armstrong was the development of wide band frequency modulation in 1933. This system is now recognized as the basis for an entirely new era in radio broadcasting and communication.

Industry's First Line of Defense
PROTECTIVE LIGHTING

By CHARLES L. AMICK
Nela Park Engineering Dept., General Electric Co.
Cleveland, Ohio

Discussions on the use of light for prevention of sabotage are not unfamiliar to readers of POWER PLANT ENGINEERING. The basic principles of protective lighting were outlined in the June, 1941 issue and subsequent numbers carried information on this general subject. While the principles of protective lighting for industrial plants remain unchanged, present recommendations should be tempered not only by the experience provided by previous installations but by today's situation regarding the availability of lighting equipment appropriate for such service. It is the purpose of this article (1) to review briefly the fundamentals upon which specific recommendations must be based, (2) to point out the possibilities offered by certain available lighting tools and (3) to present typical solutions as a guide to solving similar problems

IT IS of prime importance in the planning of protective lighting to understand how the saboteur operates in order to combat him most effectively. In general, saboteurs may be classified into two groups: (1) local "crackpots" who because of a past grievance against an industrial company or because of sympathy with the enemy undertake the willful destruction of property to impede our war effort, and (2) the professional saboteurs who belong to a large ring financed by an enemy government. The discovery of eight such agents who landed on the east coast during June gives forceful evidence of the reality and presence of this type of individual. The latter group of saboteurs is especially well organized and their work is usually neither sporadic nor haphazard and almost invariably appears as an accident—an essential of good sabotage. Objectives are usually picked with great care to do the maximum destruction to a major war industry.

Sabotage may take several forms. Arson is perhaps the most popular for it can more easily be made to appear like an accident. Explosions are considered poor sabotage, but are sometimes attempted. Other common practices include destroying machinery, injuring materials, damaging fire fighting equipment, creating accidents, causing sickness to employes by bacterial infections of water and food, and damaging blueprints, confidential files, plans, etc., to hamper production.

To perform any of these deleterious acts, the saboteur must gain access to the plant. For this reason the management must not only carefully select new employes and determine the loyalty of older workmen, but must also provide adequate protection against the entrance of outside agents by day or by night.

Fencing and an adequate guard system can usually accomplish this purpose during daylight hours, but in addition, adequate lighting is necessary to do the job at night. Darkness is the saboteur's ally and lighting therefore is industry's first defense.

Protective lighting has two main purposes, (1) to keep intruders from entering and (2) to make them readily visible and therefore easier to apprehend if they do enter. Protective lighting, however, must supplement other protection facilities (such as guards, fences, alarms, etc.) rather

Fig. 1. This boundary fence is lighted by a wide-beam projector placed along the fence line and directed in such a manner that the area outside is lighted. The illustration shows that it is easy for a guard to detect an intruder while remaining in comparative darkness

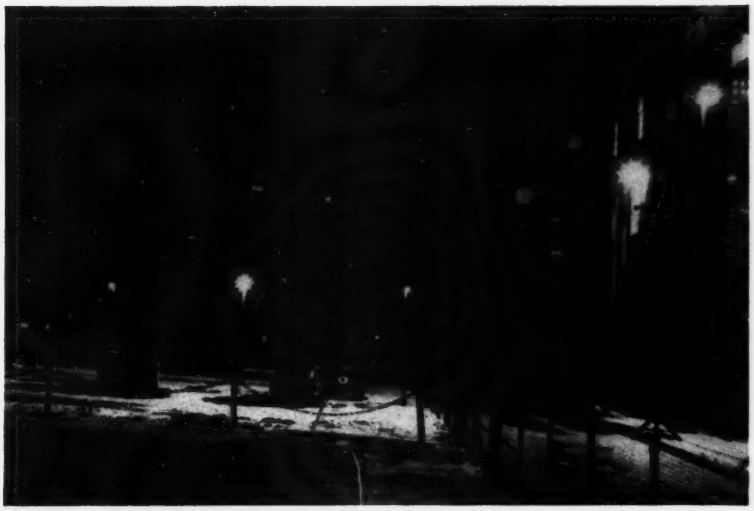


Fig. 2. (Below) All approaches to this transformer building are as clearly visible at night as by day, making the work of watchmen many times as effective in guarding its safety through the hours of the night. One-thousand-watt floodlights located on a nearby building supply the principal illumination

Fig. 3. (Right) Floodlighting of a parking lot by banks of 150-watt projector lamps mounted on the roof of the building at the right

than being the only obstacle to the would-be criminal.

The amount of light required depends upon the accessibility and vulnerability of the property. For example, particularly vulnerable locations are along highways, railroad tracks, near woods or underbrush which furnish concealment, dead-end streets at the property line, steep banks either inside or outside the fence, entrances and behind stacked-up material.

Although the quality of the light must be considered, generally speaking, the more light provided the better the guards can function. But avoid glare in the eyes of the guard. If there must be glare, arrange the units so the intruder will be blinded. Important locations should be well lighted and well guarded with the light used to protect the guards as well as the property.

There are also several other considerations worthy of mention:

1. Protect the power line feeding the protective-lighting systems.

2. Apply light paint wherever possible to create a good seeing background.

3. Make provision for turning out the protective-lighting system during a blackout, but also provide some means for guarding against intrusion during a blackout.

4. Clean and check protective-lighting equipment periodically for the maximum benefit.

5. Plan the lighting to permit the detection of sabotage before it does too much damage. For instance, if the first whiff of smoke is discovered, serious arson can often be prevented and thus life and property saved. The first few minutes are very important in fire fighting.

It should also be pointed out that while adequate lighting is essential for protection against sabotage, all non-essential illumination should be conserved. The importance of such conservation is obvious.

Protective-Lighting Equipment

Reflectors are necessary to distribute the light produced by the lamp into directions where it is most useful. Almost any desired distribution of light can be obtained to meet the particular situation. For example, floodlighting units are made for heavy-duty or light-weight service in sizes from 100 to 1500 w. and with beam spreads of 12 to 100 deg. Searchlights are made in various sizes and types, as are street-lighting units, outdoor reflectors and refractors.

There has been a great demand for equipment of this sort, however, and difficulty may be experienced in promptly securing the high-wattage floodlights and searchlights which are ordinarily thought of as being necessary to do the protective-lighting job. The hard-glass 150-w. projector lamp which has been available for several years in either the spot or flood type of distribution, offers excellent possibilities in this connection.

Some may be unfamiliar with

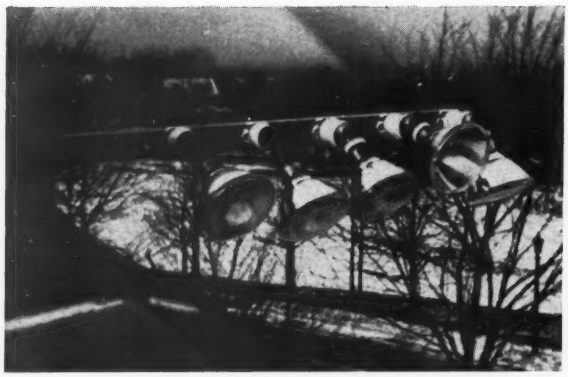


Fig. 4. An example of the simplicity and sensibility offered by Mazda projector lamps. In this instance, the installation involved only a stout 2 by 4, a couple of sandbags, porcelain sockets, angle adapters and the projector lamps

this relatively new light source (Fig. 5). The 150-w. projector lamp is a "cousin" to the all-glass sealed beam automotive headlamp as far as design and manufacture are concerned. The bulb will withstand extreme conditions of weather and the reflector, being sealed on the inside, is impervious to gases and fumes which might deteriorate exposed reflecting surfaces.

Besides having the all-important present advantage of ready availability, projector lamps are easy to install and their controlled beam makes them logical tools for short and medium range lighting. The projector spot lamp has a beam pattern similar in distribution to a 30 deg. beam floodlight and the projector flood lamp is comparable in distribution to the 60 deg. higher-wattage floodlight unit.

The survey of production areas and surrounding yards will disclose hundreds of different places where even a single projector lamp will do a most satisfactory job to correct the deficiencies of present installations.

While the use of larger groups of projector lamps as a substitute for conventional floodlighting equipment as an expedient for temporary installations is not as economical in the long run as the use of conventional equipment, such installations do have the advantage of flexibility and reliability, the latter from the standpoint of lamp outages. A burnout in a group of projector lamps is less serious than an outage of a single higher-wattage unit which would then leave a large area in darkness.

Group replacement is recommended whether ordinary floodlighting equipment or groups of projector lamps are employed for protective lighting, and particularly in the case of projector lamps installed at locations which are rather inaccessible.

While each installation requires careful and individual study before the best lighting recommendations can be given, it is possible to give general procedures to be followed in lighting different areas.

Fence Lighting

The boundary fence is the first line of defense against would-be intruders and such barriers are doubly difficult to penetrate when properly lighted. A common lighting prescription for the fence is the use of street-lighting units equipped with refractors and 300 or 500-w. multiple lamps or 6000 or 10,000-lumen series lamps. The units should be spaced no farther apart than 150 ft. and they are usually mounted 25 ft. high on poles located about 5 ft. inside the fence line.

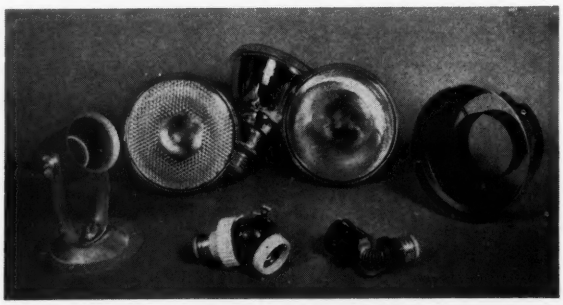


Fig. 5. The hard-glass Par-38 150-watt projector lamp is available in either the spot or flood type of distribution to fill a variety of protective and floodlighting applications. This illustration also shows some of the typical accessory equipment

Several types of refractors are available, the two-way refractor being commonly used. It is also recommended that supplementary searchlights be so placed that they can command a large area, and be mounted in such a way that they can be directed where needed by the guard. An independent power supply for the searchlight system is also a good investment.

Figure 6 illustrates one way to light boundary fences which do not border on occupied property, and Fig. 7, where the fences adjoin a highway or railroad. In every case it is well to paint the fence white or at least to whitewash it, since the intruder is generally more visible against a light background. This applies also to fences of wire netting.

Yard Lighting

Depending upon the particular conditions, the yard lighting may be in addition to the fence lighting, in place of the fence lighting or the two may be combined. Areas in the vicinity of buildings can be conveniently lighted by floodlighting projectors placed on the roof. By using care in the placement and direction of such units, the entire yard can be lighted without leaving dangerous shadows near the boundary which would provide a hiding place for the saboteur.

It is also good practice to light a large section of the yard from strategically located poles, making certain, of course, that the units are not glaring to the guards. This system is also employed to put light around stored-up material in outlying sections of the yard, preferably the light coming from more than one direction to reduce dangerous shadows. Particular care should be used in locating units if piled material is moved from place to place.

As previously indicated, the 150-w. projector spot or flood lamp is ideal for lighting small-area yards, say within 200 ft. of a building. Standard floodlighting projectors of the proper size and type are recommended for yards more than 200 ft. wide although as mentioned, banks of projector lamps serve as a satisfactory substitute if higher-wattage equipments are not readily available.

The desirable illumination level for protective lighting of the yard area ranges from 0.25 to 1 footcandle depending upon the vulnerability and importance of the location. To determine the number of units needed to supply this illumi-

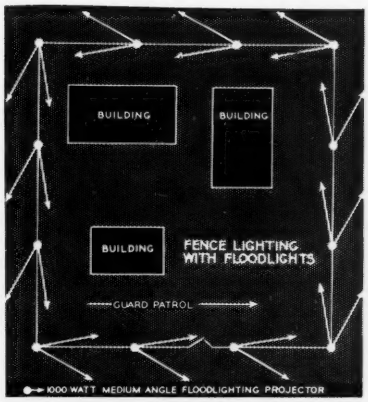


Fig. 6. Boundary fences illuminated with medium-angle floodlighting projectors. Here 1000-1500-watt lamps should be used with a 300-ft. spacing and a minimum mounting height of 10 ft. If properly directed with respect to the guard route, this type of floodlighting will be glaring to the intruder and at the same time provide maximum visibility to guards

nation, simply use the following formula:

$$\text{Number of units} = \frac{\text{area} \times \text{footcandles}}{\text{beam lumens per unit}}$$

The yard-lighting system should also be supplemented by one or more adjustable floodlighting units or searchlights which can be operated by the guard. Such units can also serve as an auxiliary system in case of an emergency if it is powered from a separate supply.

Figure 8 shows the arrangement of equipment for protective lighting in a typical industrial

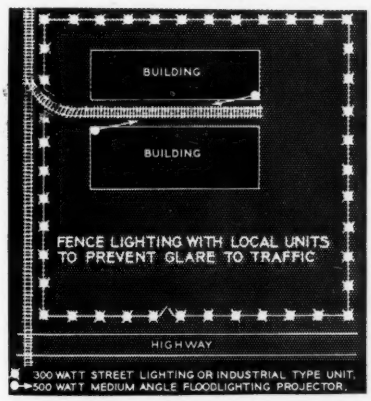

BUILDING
BUILDING
FENCE LIGHTING WITH LOCAL UNITS TO PREVENT GLARE TO TRAFFIC
HIGHWAY
300 WATT STREET LIGHTING OR INDUSTRIAL TYPE UNIT.
500 WATT MEDIUM ANGLE FLOODLIGHTING PROJECTOR.

Fig. 7. The glare from fence floodlighting units may be detrimental to motorists or train crews when fences adjoin highways or railroad tracks. The solution is the use of 300, 400 or 500-watt lamps in street-lighting or industrial-type units mounted about 25 ft. high and spaced about 75 ft. apart. The units shown at the corner of each of the two buildings are medium-angle floodlighting projectors

plant yard and Fig. 9 plan for a factory in a restricted area where ordinary floodlighting equipment would disturb the occupants of nearby residences.

Entrances can be lighted either by floodlighting projectors on roofs of nearby buildings or by street-lighting units. The problem is simply one of providing sufficient light so that anyone approaching can be seen quickly and scrutinized.

An appreciable area around the entrances should also be lighted so that intruders who are able to dash within the entrance will not be lost immediately to the view of other guards.

Substations

Both substations and principal generating stations are particularly susceptible to sabotage because of

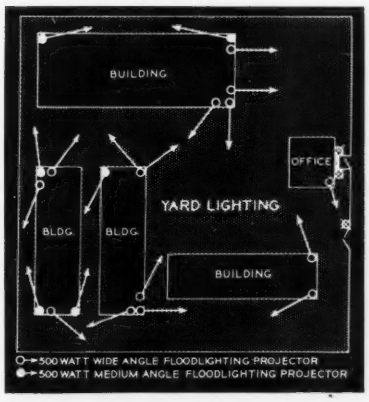


Fig. 8. Either wide or medium-angle floodlighting projectors can be used for yard lighting, depending on the area to be illuminated. The units are generally mounted atop buildings and use 200 to 1500-watt lamps, depending on the area to be lighted. They should be placed to give good coverage. In the sketch above, the solid dots represent medium-angle floodlighting projectors and the circles wide-angle floodlighting units

their important role in the war production effort. Around the central station it is well to take particular precaution in the protection of feedwater supplies, cooling ponds or towers and coal-handling machinery.

Floodlighting units on the station roof can be employed frequently to protect these vulnerable spots, although a pole-mounted unit is sometimes necessary to light isolated cooling ponds or towers.

The most vital point of substations are the transformers. While substations are usually well lighted inside to facilitate maintenance and inspection, it is well to floodlight the surrounding areas by conventional units located atop the steel structure. River approaches should

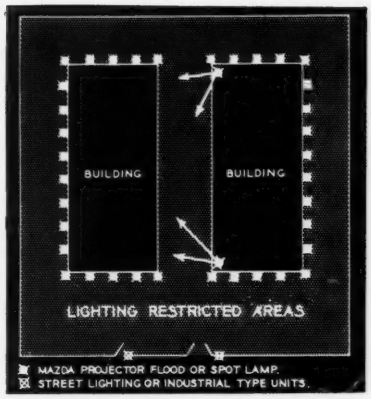


Fig. 9. For factories in restricted areas, the 150-watt projector flood or spot lamp spaced on 20 to 30-foot centers will do a good job of illuminating building approaches. The drawing shows a typical application. The units at the entrances are street-lighting or industrial-type units

be illuminated with the light directed across the river to avoid glare to navigation.

Obviously, with reliability an important factor in protective lighting, considerable attention should be given to the wiring system to that the lighting cannot easily be put out of service simply by cutting exposed wires. The use of underground wiring is best, or if on or above the surface, the wiring should certainly be in rigid conduit.

A loop power circuit is desirable although perhaps does not justify the amount of copper required. It is also advisable to keep a supply of the lamps used in the protective-lighting system on hand so that burnouts can be promptly replaced.

The Bureau of Reclamation reports that Grand Coulee Dam has provided new sources of power vital to the prosecution of the war at an average rate of 1000 kw. per day during the past two yr. In December, 1942 parts for the turbine of a fourth 108,000 kw. generator began arriving and assembly will start as soon as sufficient parts are on hand. It is expected that this unit will be in operation in July, 1943, that the fifth 108,000 kw. unit will be ready in December, 1943, and the sixth in March, 1944. This ultimate installed capacity of nearly 700,000 kw. will be surpassed only by Boulder Dam and a substantial portion of it will go toward the 12½ million kilowatts that must be made available to our war plants by 1944. Grand Coulee Dam's new energy will be used almost entirely by aluminum reduction plants, shipyards and factories making implements of war.

DIESELS AT NATCHITOCHES

The municipal plant in the oldest city of the Louisiana Purchase despite its irregular growth over a period of years is a municipal showplace as well as an efficient, well regulated plant. The recent installation of a new 1000-hp. generating unit brings the plant to a high point in its long history of continuous power development

By William H. Gottlieb

IT IS COMPARATIVELY simple to design an efficient and attractive 2500-hp. Diesel plant, but the problems multiply when the plant starts operations with a modest 150-hp. unit and expands to the 2500-hp. capacity in half-dozen jumps. The result frequently is an ugly, disorderly power house with a makeshift conglomeration of equipment and operating systems.

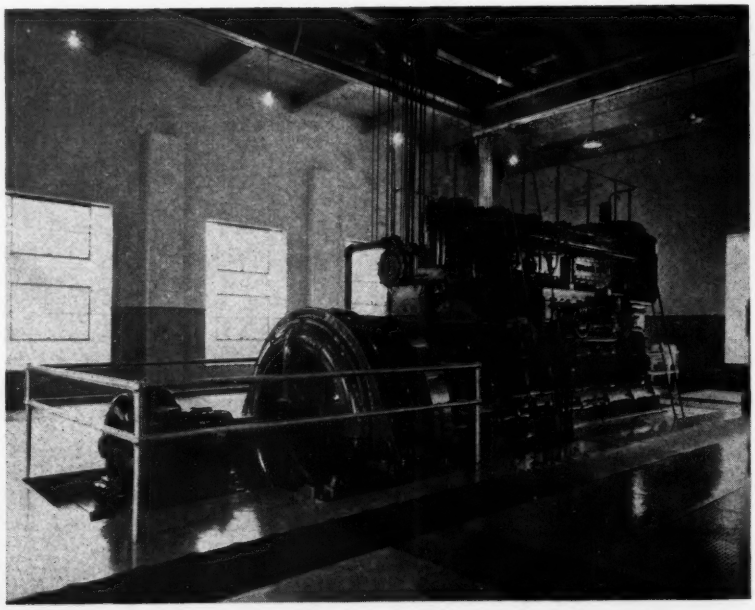
The municipal power plant of Natchitoches, La., has solved this problem of irregular growth and emerged as a municipal showplace with well planned, integrated systems for handling fuel, lubricating oil and cooling water.

The power plant of the oldest city of the Louisiana Purchase climaxed its development with the installation in 1940, of a 1000-hp. McIntosh & Seymour Diesel. Other elements in the improvement program were power house renovation, the installation of a new 8-panel switchboard and improvement of the lube oil and cooling water systems.

From the outset, the Diesel plant has paid its own way, amortizing the cost of equipment from plant revenues. The first engine, a 150-hp. Fairbanks-Morse 'hot-head' unit, was installed in 1920 and this, like all subsequent additions, is still in operation. It drives directly a 100-kw. F-M generator with belted exciter.

A 300-hp. engine of the same type directly connected to a 200-kw. F-M generator with chain-driven exciter, was installed 4 yr. later.

The next addition, in 1926, was a 360-hp. Fairbanks-Morse full Diesel direct-connected to a 240-kw. generator which depends for excitation on a 20-kw. motor-gen-



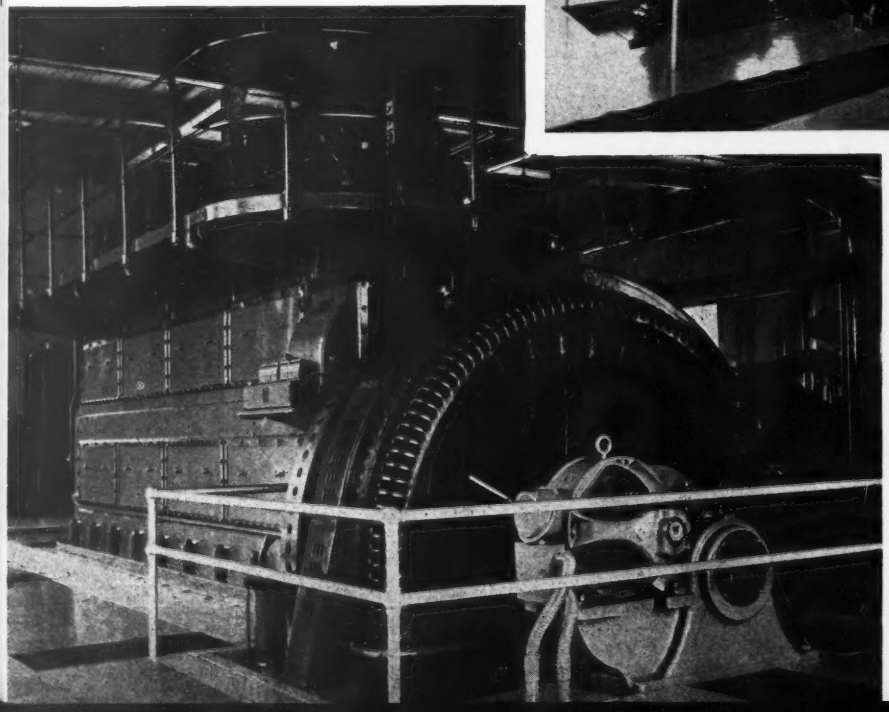
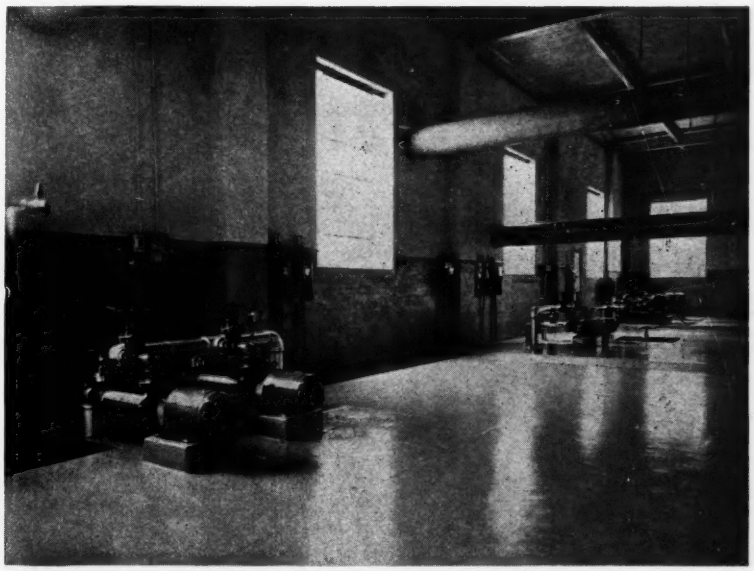


Fig. 1. (Left) A close-up of the new 1000-hp. Diesel engine generating unit at the Natchitoches Municipal Plant. Note how the exciter is mounted directly on the bearing block

Fig. 2. (Above) A view of the second largest Diesel engine unit at Natchitoches. This is a 750-hp., 2-cycle machine

Fig. 3. (Below) Four pumps in the foreground supply all the Natchitoches Diesel engines with cooling water. The city water service pumps can be seen in the extreme background

Fig. 4. (Right) A general view of the interior of the Natchitoches power plant showing the five Diesel engines totalling 2560 hp.



erator set. Second largest unit in the plant is a 750-hp., Model 33, F-M Diesel driving directly a 512-kw. generator with direct-connected exciter.

A year ago, when the rapidly increasing load necessitated a major plant expansion, Natchitoches installed an 8-cyl., 17½ by 25-in., 4-cycle, mechanical-injection, McIntosh & Seymour Diesel rated at 1000-hp. at 225 r.p.m. It drives, directly, a 700-kw. Westinghouse generator with chain-driven exciter.

The city spared nothing in providing the new engine with protective auxiliaries. Engine air is drawn from outside the plant through an oil bath filter. The 750-hp. unit, too, is equipped with a filter of this type.

A large duplex, activated clay reclaimer installed in a new basement section, purifies lubricating oil for the entire plant. The sump tank for the 1000-hp. Diesel also is placed in this basement section.

The engine pump takes oil from the tank, sends it through a cooler and filter to the bearings under pressure. Oil from the return lines drains back to the sump. The reclaimer, in continuous operation, takes oil from the sump at the return end of the tank, purifies it and returns it to the end of the tank where the engine pump has its suction.

A motor-driven auxiliary pump is used to bring up lubricating oil pressure in the new engine before starting and to keep it up while slowing to a stop. This pump also serves as an emergency standby in case the main lubricating oil pump fails. Supplementing the pressure lubricating system is a mechanical lubricator which serves the cylinders.

In the case of the 750-hp. unit, all oil caught by the cylinder wiper rings drains to a tank in a half pit in a corner of the engine room. The reclaimer in the basement purifies this oil and returns it to the engine crankcase.

A motor-driven, rotary pump can be used to transfer oil between one engine and another. Oil from the three smaller engines drains to a dirty oil tank and is cleaned up in batches and stored in a clean oil tank to await return to the engines.

Fuel is unloaded by a motor-driven centrifugal pump and stored in two 10,000-gal. tanks above ground A motor-driven rotary pump transfers fuel from storage through a filter and a meter, to three 250-gal. day tanks overhead in the engine room, that serve the 1000-hp. engine. Fuel flows by gravity to the suction of an engine-driven pump which sends it through a duplex, pressure filter to the individual injection pump for each cylinder.

Day tanks for the other engines are below ground and supplied from storage by gravity. Quantities of fuel injected are regulated for the two major units by hydraulic-relay governors. The governor settings can be controlled from the switchboard. Also on the switchboard is a voltage regulator for each engine.

To protect engine jackets against scale, a closed cooling water system is provided for the entire plant. All engines are supplied through branch lines from an 8-in. pipe located under the engine room floor, which serves as a header. Water from the engines flow to a hotwell outside, then to a pair of motor-driven, 250-g.p.m., centrifugal pumps which circulate it through the coils of a cooling tower and then to the header which supplied the engines.

A second pair of pumps of the same size and capacity take raw

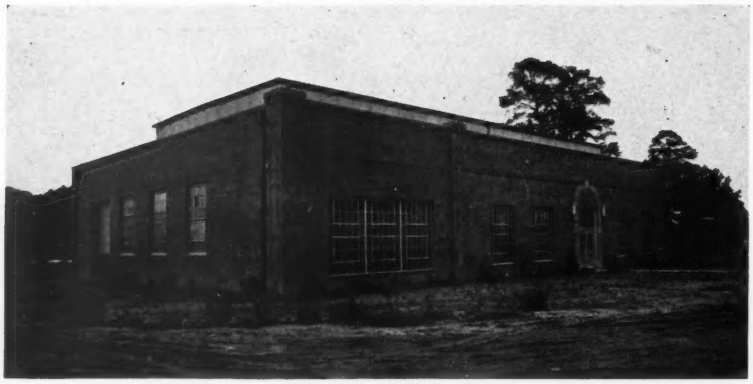


Fig. 5. The Natchitoches, La., municipal lighting plant after the installation of the last engine

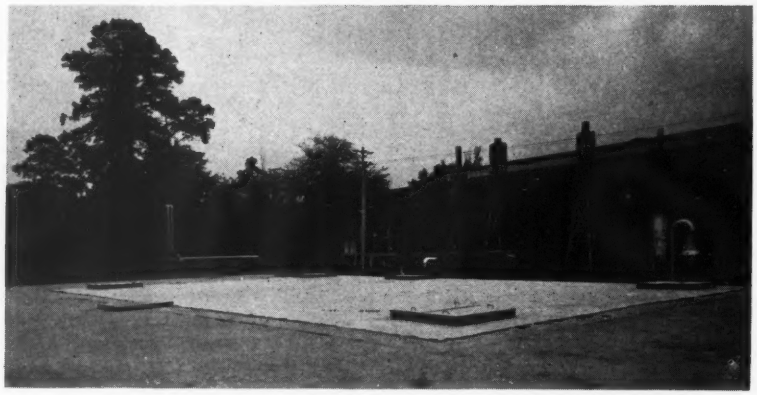


Fig. 6. Another exterior view showing the exhaust silencers and cooling tower

water from the cooling tower sump and pump it over the tower. A valve is arranged so that city water can be admitted as make-up to either the raw or jacket water circuits. Soda ash is added to soften the jacket water. If pumps should fail, water under city pressure can be routed through the engine jackets.

The plant is close to a residential section and an exhaust silencer located outside the plant has been provided for each engine. The noise is slight and neighbors have found no cause for complaint. Engines are started by air supplied by two motor-driven compressors.

There are two men on duty at the plant at all times as well as the chief engineer who is usually present through the day shift. Despite careful attention to operating engines, the engineers took the precaution of providing an alarm system for their major equipment. A howler on an alarm panel near the 1000-hp. unit sounds a warning if either cooling water or lubricating oil temperature goes too high.

The board also holds an exhaust pyrometer and pressure gages which are checked periodically by the operator. If anything happens to a gage, a light on the board goes off. The pyrometer serves not only the new engine but two of the smaller units. The 750-hp. engine has alarms on the water and the lubricating oil pressure lines and an exhaust pyrometer is provided which also serves the 360-hp. Diesel. There is a pressure alarm on the cooling water header.

During the summer months, the demand for electricity reaches a peak of more than 1000 kw. Ice

(Continued on page 64)

PRINCIPAL EQUIPMENT AT NATCHITOCHES, LA., MUNICIPAL PLANT

Engines

1 1000-hp., 8-cyl., 17½ by 25-in., 4-cycle, 225 r.p.m., mechanical-injection Diesel. McIntosh & Seymour.

1 750-hp., 5-cyl., 257 r.p.m., Model 33, Style M Diesel. Fairbanks-Morse & Co.

1 360-hp., 6-cyl., 257 r.p.m., Type Y, Style VA Diesel. Fairbanks-Morse & Co.

1 300-hp., 6-cyl., 257 r.p.m., Type Y, Style V Diesel. Fairbanks-Morse & Co.

1 150-hp., 3-cyl., 257 r.p.m., Type Y, Style V Diesel. Fairbanks-Morse & Co.

Generators

1 875 kv-a., 700-kw., 2400-v., 3-phase, 60-cycle alternator with chain-driven exciter. Westinghouse Elec. & Mfg. Co.

1 640 kv-a., 512-kw. alternator with direct-connected exciter. Fairbanks-Morse & Co.

1 300 kv-a., 240-kw. alternator with motor-generator set for excitation. Fairbanks-Morse & Co.

1 250 kv-a., 200-kw. alternator with chain-driven exciter. Fairbanks-Morse & Co.

1 125 kv-a., 100-kw., 2300-v., alternator with belted exciter. Fairbanks-Morse & Co.

Governors

Relay-type for 1000-hp. and 750-hp. units. Woodward Governor Co.

Fuel System

Fuel Oil—Grogan Oil Co. and Simmons Oil Co.

Unloading Pump—Fairbanks-Morse & Co.

Transfer Pump—Viking Pump Co.

Meter—Hersey Mfg. Co.

Filters—Cuno Engineering Co. and Nugent Mfg. Co.

Lubricating Oil System

Lube Oil—Tereso 65. Standard Oil Co. of La.

Reclaimer—Model H1 Hilco. Hilliard Corp.

Auxiliary Pumps—For 1000-hp. unit, Viking Pump Co.; for 750-hp. unit, Trahern Pump Co.

Lubricators—For 1000-hp. unit, Manzel Bros.; for other units, Madison-Kipp.

Coolers—For 1000-hp. unit, Ross Heater & Mfg. Co.; for 750-hp. unit, Schutte & Koerting.

Filters—For 1000-hp. unit, Cuno Engineering Co.; for 750-hp. unit, Schutte & Koerting.

Cooling Water System

Pumps—4 250 g.p.m., centrifugal pumps. Worthington Pump & Machinery Corp.

Cooling Tower—Marley Co.

Silencers—Maxim Silencer Co.

Air Filters—American Air Filter Co.

Pyrometers—Brown Instrument Co.

Air Compressors—Fairbanks-Morse & Co. Worthington Pump & Machinery Corp.

Switchboard—General Electric Co.

Voltage Regulators—General Electric Co.

Alarm System—For 1000-hp. unit, Detroit Lubricator Co.; for 750-hp. unit, Marshalltown Mfg. Co.; for water header, Ashcroft-American.

Pressure Gages—U. S. Gauge Co.

Hoists—One 2-ton and one 10-ton. Wright Mfg. Co.

Supervisory Personnel

Mayor—E. L. McClung.

Commissioner of Finance—G. H. Pierson.

Commissioner Over Utilities—A. F. Ortmeyer.

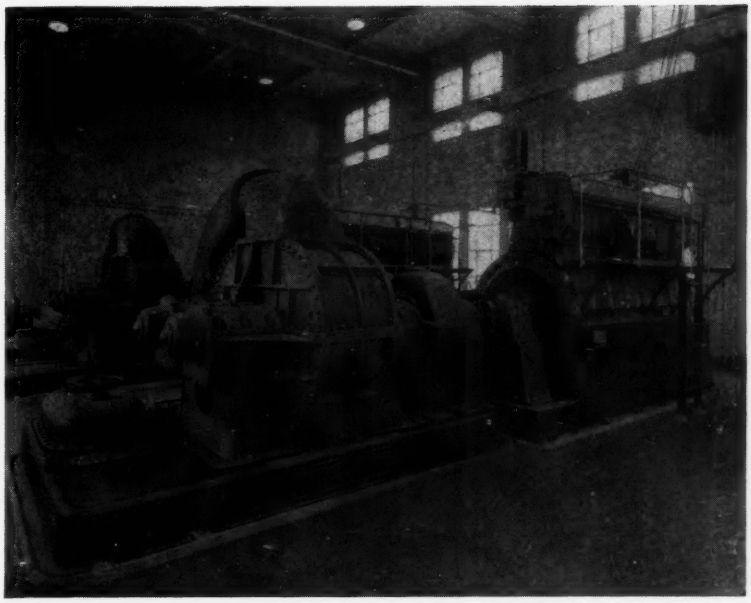
Secretary and Treasurer—Geo. C. Sutton.

Superintendent—S. L. Perry.

Chief Engineer—J. D. DeBlieux, Jr.

Fuel Oil Specifications

Color—Straw.
Baumé at 60 deg. F.—36.1.
Spec. grav. at 60 deg. F.—0.8429.
Wt. gal. at 60 deg. F.—7.018.
Flash point (pmcc)—171 deg. F.
Viscosity at 100 deg. F.—36.5 sec.
Carbon residue—0.01%.
B.t.u. No. high—19.545.
Sulphur—0.26%.



Two Cooper-Bessemer Corp. engines installed at the Cleveland Southerly sewage treatment works at Cuyahoga Heights, Ohio, running on sewage gas

Use of Sewage Gas Aids Fuel Conservation

THE USE OF SEWAGE GAS in internal combustion engines is not new; a number of towns throughout the country have used sewage gas effectively for many years. While the use of this waste fuel is always desirable it offers particular attractions in these times as means of conserving our normal fuel resources.

The savings effected by the use of sewage gas in this manner are well illustrated by an installation in Cleveland where the operation of two engines on sewage gas at the Southerly plant of the Cleveland Sewage Disposal Department results in a saving of $10,000 annually. At the same time, it is making available for other uses, natural gas or other fuels that would otherwise be required in producing the power.

The gas readily available as a by-product in the country's sewage plants represents an appreciable amount of fuel and further utilization of this fuel might well be encouraged. In the Cleveland plant alone it is reported there is sufficient gas to operate three additional engines and at the present time changes are being made in the plant to use some of this gas in burning sludge and other operations.

Many an average-size sewage plant, now wasting its gas, could heat its own buildings, incinerate sludge, heat the sludge in digestion tanks as well as generate power for lighting and the operation of machinery.

No special arrangements or accessories are required to operate gas engines on sewage gas. In the Cleveland plant the two units are standard 8-cylinder engines with a bore of 11½ in. and a stroke of 13½ in., developing 420 hp. at 420 r.p.m. These engines are Cooper-Bessemer Corp. units driving blowers to discharge aeration tanks. They are designed for operation either as straight Diesels, or to utilize natural gas as fuel, whichever is most economical in the particular locality. They can be readily adapted for either type of operation, the only changes being necessary are the substitution of the injection system for the ignition system and a few simple changes in the power cylinder liner and pistons.

This conversion feature is a decided advantage. Should the engine be installed for operation on gas and the cost of gas increase beyond a certain point, or the supply suddenly be exhausted, it can quickly be converted to a full Diesel. Or should it first be installed as a Diesel, and some other fuel later prove more economical, the engine can just as easily be converted for operation on the other fuel.

Nor is any special processing of the sewage gas required to make it suitable as fuel. According to G. E. Flower, superintendent of the Cleveland plant the efficiency of the engines should be the same whether sewage gas or natural gas is used. The hydrogen sulphide content of the sewage gas is practically zero, methane runs 65 per cent, carbon dioxide, 30 per cent and nitrogen 5 per cent. As an engine fuel, sewage gas compares favorably with other gases. Its heating value will run from 600 to 700 B.t.u. per cu. ft.

At present, internal combustion engine driven power plants in sewage plants fall into two divisions. The first may be classified as one in which gas engines are directly connected to the plant's electric generators. Here, the sewage plant is able to generate enough gas to operate engine-generating units continuously, and the electricity thus generated, in turn, is used to operate motors to drive blowers, sludge pumps and a multitude of other motors used about the plant.

The other division may be classified as one in which gas engines are directly connected to blowers or other sewage equipment. This second method is generally used when the gas supply is not sufficient to provide enough fuel to carry the entire plant load. Blowers are one of the largest consumers of power in the plant.

Whatever the type of installation the utilization of sewage gas as an engine fuel can be an important factor in our fuel conservation program. What Cleveland has done, other cities can do. If every sewage plant in the country would take similar steps, it would greatly lessen the fuel-shortage problem.

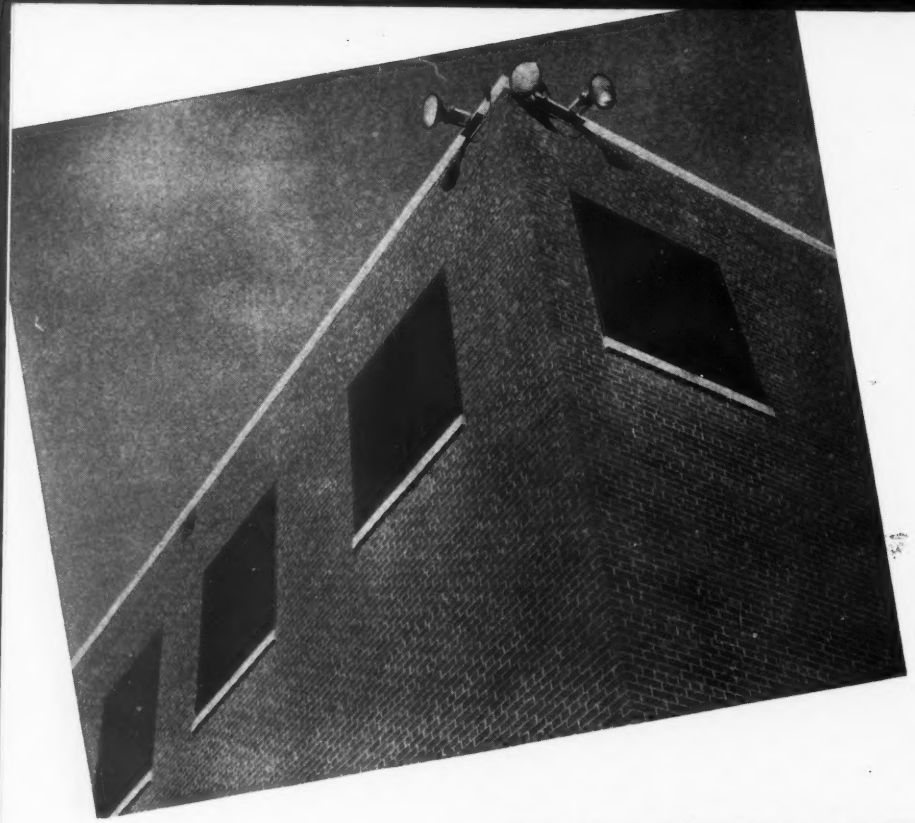


Fig. 1. The new boiler plant for the Allis-Chalmers supercharger plant is one of the first "blackout" boiler plants. It has no windows or skylights. Air requirements for the boilers and for ventilation are provided by these light tight louvres placed in the walls

WARTIME BOILER PLANT DESIGN

When the Allis-Chalmers Co. built their new supercharger plant in Milwaukee early last summer the project included a boiler plant to furnish the steam needed for heating and process work. Even though this was a "war plant" of the most vital importance, great care was used in specifying the materials for this boiler plant with a view of conserving critical materials as much as possible. Not only were second-hand boilers installed but in many elements of the design substitute materials were used. In some instances where steel was specified originally, concrete was substituted during the process of construction. When a second factory unit was decided upon the substitution of concrete for steel was carried to even further lengths. The second unit is now being built. Of particular interest are the concrete ash hoppers underneath the boilers. These were to have been of steel, but as steel became more difficult to get concrete was used instead. Aside from these features the plant is of interest because this is one of the first "blackout" boiler plants

IN wartime today, the pinch on critical materials is so great that even the most vital of war plants must be constructed with an eye to conservation and careful utilization of materials most readily available. No exception to this is the construction of the new war factory's power plant.

Few production units are more important in the formation of America's war machine than the new supercharger plant of the Allis-Chalmers Mfg. Co. at Milwaukee, Wis. At its dedication recently, Army Air Force officials described the product manufactured in this new factory as "America's ace in the hole," a device that enables Flying Fortresses to fly above the range of Hitler's anti-aircraft guns.

In their production, a great quantity of power is required, primarily for the essential operations of testing the much-needed aircraft superchargers.

Yet, in designing and constructing the power plant for the supercharger unit, great care was exercised in specifying critical materials, and the conservation orders of the War Production Board were complied with wholeheartedly. Many instances were found where the use of certain types of construction or kinds of material would sacrifice nothing in the plant's efficiency, yet hasten the plant's erection and aid the war effort in general.

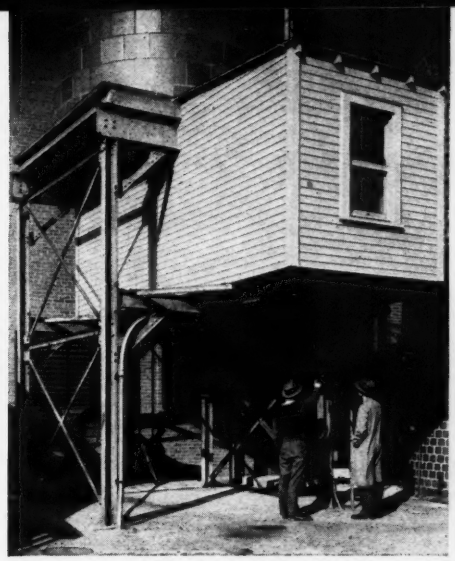
A major step in line with WPB conservation orders was the substitution and use of two second-hand boilers in place of new ones. Special adaption procedures were necessary, since these WPB orders were issued after erection of the plant boilers had actually begun.

To begin with, WPB itself helped out by providing a service list of used boilers available. Basic requirements of capacity, etc., eliminated all but a few of these automatically, and those still to be considered were personally inspected by a representative of Sargent and Lundy, the constructing engineers.

During the course of inspection of these boilers, most of which were located in the East, others were discovered nearer the super-

Fig. 2. (Right) Steel construction supported the ash storage for the first supercharger plant

Fig. 3. (Extreme Right) Following WPB recommendations concrete was substituted for the columns of the second ash storage unit



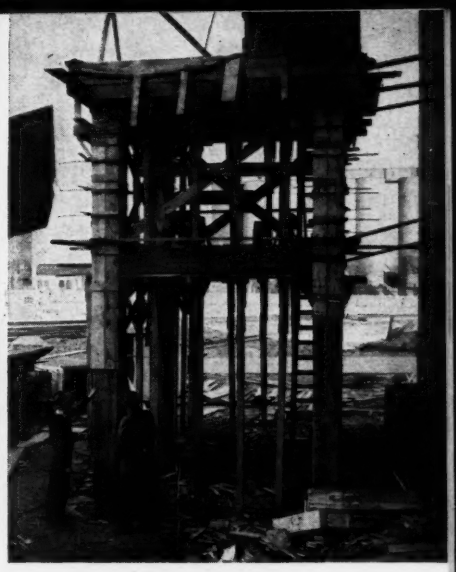


Fig. 4 and 5. Still another instance where original steel construction was abandoned and concrete used in its place was in the ash hoppers underneath the boilers

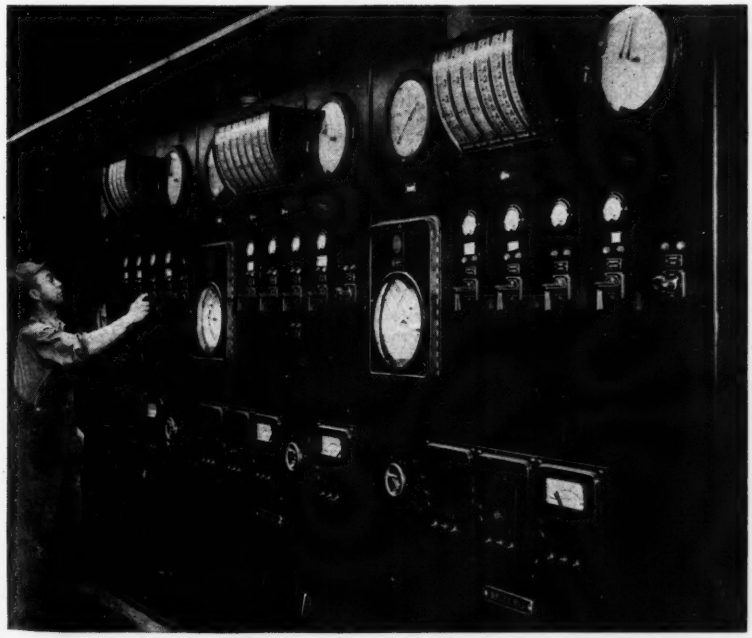


Fig. 6. (Left) The control board for the boilers in the boiler plant of the Allis-Chalmers supercharger factory

charger plant site, an obvious advantage.

It was found that by redesigning the furnaces and making other changes, these boilers could be made to fit into the space requirements provided for the new boilers. This could be done with relatively small changes in substructure work, which had already been completed, and it was, therefore, decided to use these boilers.

En route from their original installation to the new plant, the boilers were knocked down and repaired and remodeled, with the help of the boiler manufacturer. Furnace volume was expanded to increase steam produced by 2½ times. Needless to say, the use of

Fig. 7. With the major phases of the conversion completed by the manufacturer before the second-hand boilers were moved to the Allis-Chalmers supercharger plant, the boilers were quickly installed, maintaining the high-speed schedule of construction that was set for the entire project. Delays which probably would have resulted if new equipment had been specified were thus largely avoided

these boilers conserved a considerable amount of steel. Then, to conserve further on critical materials, a good portion of the structural steel was eliminated, and reinforced concrete was used instead.

Streamline Supercharger Unit

In discussing other characteristics of the boiler house, it might be well to consider first the building proper. The boiler room is located in a wing of the main plant, and, consequently, its architectural features conform to the rest of the building. The supercharger unit is a streamlined, windowless plant, the first real blackout factory in the Milwaukee area. As a result, unlike most boiler rooms, there are no windows or skylights, the omission of which was to conform to passive defense requirements suitable for blackout protection.

To accommodate considerable air requirements by the boilers for combustion and that necessary for ventilation, light-tight louvres were placed in the walls, and so designed and arranged to blend with the exterior brick facing.

The steam demand for the plant is based on that required for testing superchargers, shop heating, and forge shop equipment. Extreme load fluctuations dictated forced and induced draft fans for each boiler.

As an economy measure, for light load periods, two boilers are arranged for natural draft, and in an emergency, due to power interruptions, the forced draft fan for one of the boilers has, as an alternate, a turbine driver. The boiler feed pumps are also turbine driven.

The plant as a whole is well instrumented to provide the operator with thorough understanding of plant operation. Automatic combustion control is also provided to gain the utmost in boiler efficiency under wide load conditions.

Since make-up water is nearly 100 per cent, a water treating plant consisting of hot process softener and filtering equipment is used.

Coal-Fired Boilers Are Used

Fuel used for these boilers is coal and a suitable coal conveying system is provided, which can accommodate coal delivery by either train or trucks. The coal is stored in overhead bunkers, and fed to the boilers by spreader type stokers.

The ash handling system consists of a vacuum type conveyor with suitable storage facilities and means for dustless loading of ashes to trucks.

Conforming to modern power plant practice where a boiler plant is located near residential sections, a dust collector is provided to entrain practically all of the fly ash from boiler exit gases to the stack. Means for handling collected ashes are also included as a part of the stoker ash conveyor system.

DIESELS AT NATCHITOCHES

(Continued from page 60)

plants and fish hatcheries provide a 24-hr. demand, and theatre and residential cooling systems are in operation. The pumping load, which only 3 yr. ago was 250,000 g.p.d., rises now to 1,000,000 g.p.d. During these peak months the new engine is operated about 12 hr. per day.

In the off season load conditions dictate about 7 hr. of daily operation. An effort is made to run the big engine with a good load factor whenever possible and as a result it has produced a consistent record of 14 kw-hr. per gal. of fuel. Lubricating oil consumption for this unit is 4000 hp-hr. per gal. of lubricating oil.

There were no repairs at all for the new engine in its first year of operation. The total bill for machinery repairs for the entire plant in 1940 was $194.39. Total production costs for the year, including salaries, were $24,626.70 or a cost at the switchboard of 8.8 mills per kw-hr. for the total production of 2,789,880 kw-hr. Income from sale of power and light to 1035 residential consumers, 231 commercial and 40 industrial consumers amounted to $80,966.32. Water revenues brought the total to nearly $100,000.

The plant's first great contribution to the citizens of Natchitoches was to cut electric rates in half in the past 10 yr. Plant earnings have built up a power and water system valued today at $750,000. The plant is free of bonded debt. Only $24,000 per yr. is collected in taxes, the power system supplying an additional $50,000 or more. This fund supports the police, health and street departments as well as the 11-man payroll of the city recreation center. Among the plant's contributions have been $75,000 for a municipal golf course, $10,000 for interest on airport bonds, $75,000 for the recreation center, $8800 for an armory and $4500 for a jail.

In addition the plant supplies, without charge, power for street lighting, water pumping, schools, churches, the city's noted Christmas lighting display and other civic purposes.

The successful Diesel plant obviously is an important factor in the development of the city.

Better Ink Records With Recording Instruments

Here is a good article on a subject on which very little has been written. Recording instruments are in wide use throughout industry. It is to the credit of the designers that the greater part of these operate satisfactorily with very little attention. To keep them in perfect shape however requires some knowledge of the characteristics of the inking mechanisms as well as the inks used and in this article the author presents such information. If nothing more, keep this article in your files for the day when your recording mechanisms give you trouble, but you can anticipate trouble by rules laid down here

By L. J. Lunas, Instrument Design Engineer, Meter Div., Westinghouse Elec. & Mfg. Co.

THE EARLIEST electrical recording instrument was undoubtedly Kelvin's 'siphon recorder' which was used to receive code messages in sub-marine telegraphy. In this instrument the record was made by means of a siphon form of capillary pen, with ink on a paper record strip.

The quality of recording instrument chart records produced by ink marking has not been surpassed or even equalled by any other recording means. Ink produces a clear, continuous permanent record of the instantaneous variations of the measured quantity.

One of the greatest advantages of the ink marking system is the fact that the flow of ink from the writing tip to the chart acts as a lubricant and reduces the friction of the polished writing tip so that the accuracy of the instrument is unimpaired and the energy required to operate the instrument is reduced to a minimum.

The ideal ink for recording instruments should have the following properties:

1. Produce fine, clearly marked records.

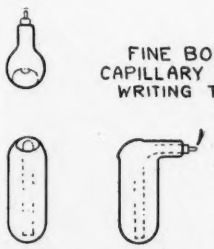


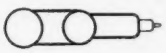
Fig. 1. Reservoir pen—Direct acting recorder

2. Dry on chart rapidly enough to prevent blotting when rerolled.
3. Not evaporate too rapidly from the inkwell or pen reservoir.
4. Flow freely without clogging the pen.
5. Leave no residue or sediment to collect in the reservoir or pen.
6. Should not corrode the pen or inkwell reservoir or have any chemical reaction which would cause an accumulation of foreign matter or debris.
7. Should operate over a wide range of temperature, humidity and altitude (pressure).
8. The recorded chart should produce clear, contrasting blueprint reproductions.
9. The record should not be affected by chemical bleaching fumes such as chlorine, which may be present at the plant in which the recorder is located.
10. The ink should keep for long periods of time in storage without deterioration or change in characteristics.

Some of these requirements are incompatible and it is necessary to utilize a compromise solution to obtain the most desirable balance of properties. For example, an ink that dries rapidly on the chart so that it will not blot when the chart is rerolled, contains a large proportion of easily evaporated solvents which will also evaporate quickly from the inkwell reservoir or pen. Likewise, an ink designed to operate at low temperatures without freezing usually contains a high percentage of alcohol or some similar volatile anti-freeze compound which evaporates rapidly if the ink is used in a normal or high temperature application.

Other Ink Considerations

A further consideration is the type of recorder in which the ink is used. For example, a circular



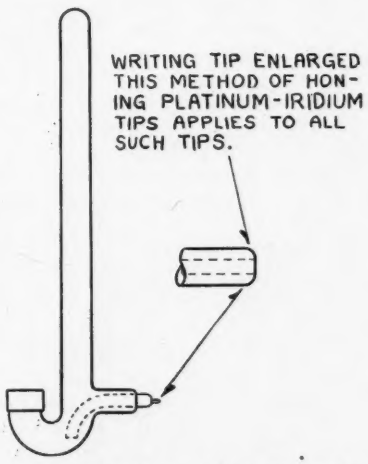


Fig. 2. Reservoir pen—Relay type recorder

chart recorder having a relatively small, light weight, low capacity pen reservoir, with the chart rotating only once in several days or a week, must have a slow drying ink which will not completely evaporate from the pen before the chart rotation is completed and the recorder serviced. In this case, the reroll feature of strip chart recorders is not present to cause blotting of the record.

It is therefore apparent that there is no single answer to the

ink problem for all types of recording instruments under all conditions, and that an ink designed for use in a particular type of recorder under definite conditions should be used to obtain the most satisfactory records.

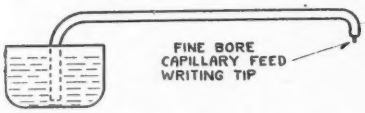


Fig. 3. Reservoir pen with fine bore capillary feed

In working out the simplest solution to this complicated problem over the past several years, certain premises or conditions were laid down. (The following is on the assumption that the paper used is of a suitable quality for the purpose):

Inks were developed in only two different colors which experience indicate are suitable for practically all applications, namely, red and green.

Types of Inking Systems

Two general types of inking systems were involved, first, the strip chart recorder equipped with relatively large inkwell or reservoir and second, the circular chart, or strip chart recorder which for simplicity and low cost is equipped with a pen reservoir on the pen itself and is thus limited to light weight and low ink capacity.

The large inkwell capacity of the first type recorder mentioned, permits the use of an ink which will dry rapidly on the chart so as not to blot when rerolled, and yet will last long enough to allow for servicing once every week or two.

The second type of recorder having relatively small pen reservoir capacity must, of necessity, use a slower drying ink so as not to require too frequent service periods.

In the case of strip chart recorders equipped with rerolls and small pen reservoirs, the chart speed must be limited to slow speed such as 1 in. per hr. to allow the ink on the record time enough to dry sufficiently to prevent blotting when rerolled.

It is thus plain that to satisfy the requirements of the two general types of inking systems operated under what might be termed normal conditions of temperature, humidity, altitude, chart speed, and character of load (fluctuating rapidly or else fairly steady with all gradations in between), it is necessary to provide two different types of ink; one relatively quick drying and one slow drying.

These drying properties are regulated by the percentage of water, glycerine, alcohol, and other materials used in mixing the ink.

The standard inks produce satisfactory records for most applications, but there are occasional installations operated under extreme conditions of load fluctuation, temperature humidity or altitude which require speeding up or slowing down the drying time.

In the case of freezing temperatures, it is possible to obtain good performance at considerably reduced temperatures by mixing the ink with grain alcohol using up to 20 per cent alcohol by volume. In the case of high temperatures the drying time can be slowed by mixing glycerine with the ink.

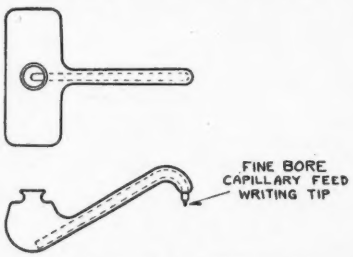


Fig. 4. Reservoir pen—Unit construction

To prevent corrosion of ink changing color, the user should use only the ink developed for his type of instrument. Inkwells made of different metals or alloys may have chemical reaction set up if an ink other than that developed and recommended by the manufacturer is used. The least that may occur is a change in the color or intensity of the record, but in extreme cases bad corrosion and pen clogging occur.

For Blueprint Reproductions

To produce contrasting blueprint reproductions, the ink must contain dyes highly opaque to the color of the light to which the blueprint paper is most sensitive. Tests of various available recording instrument inks show that very few produce satisfactory blueprint reproductions and yet many users rely on such reproductions to produce copies of record charts for their system studies.

A systematic research of dye constituents has brought forth an ink made with certain dyes which produce brilliant, pleasing permanent colors, and yet are as opaque as black India drawing ink and produce as satisfactory blueprint records.

Trouble Shooting

Field troubles can sometimes be traced to a roughness of the pen point, or a damp condition of the paper chart, or a fluctuating or pumping action either in the circuit or in the instrument proper. Sometimes a blotting or unsatisfactory record is erroneously ascribed to the quality of the ink or of the paper.

A few general rules may help to eliminate inking troubles:

1. Ink reservoir and pen must be clean. If a recorder is taken out of service for more than a day or two the inkwell, pen and writing point should be thoroughly cleaned. This will not only prevent spillage in case the instrument is moved, but will eliminate the clogging of pens, deposits in reservoirs and troubles that would be experienced in getting the inking system into operation the next time the instrument is placed in service.

2. Never mix different makes of inks or attempt to use a different kind of ink without thoroughly cleaning the inkwell, pen and writing point. Normally, water is sufficient to dissolve and clean any ink or residue. In stubborn cases, hot water or alcohol may be necessary to dissolve residue of ink allowed to dry for a long time in the inking system.

3. The writing point must be smooth and not allow too much or too little ink to flow. Fine-bore platinum iridium writing tips have practically indefinite life and require little attention, but must not be allowed to stand idle for long periods with ink which will dry and harden in the bore.

Open V-type metal pens will stand more abuse of this type, but require periodic attention in stoning the tip as the relatively soft material wears more rapidly than the platinum iridium tubular tip.

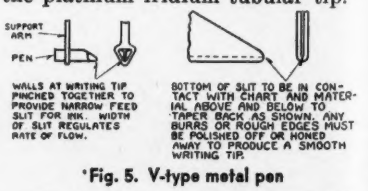

SUPPORT ARM
PEN
WALLS AT WRITING TIP PINCHED TOGETHER TO PROVIDE NARROW FEED SLIT FOR INK. WIDTH OF SLIT REGULATES RATE OF FLOW.
BOTTOM OF SLIT TO BE IN CONTACT WITH CHART AND MATERIAL ABOVE AND BELOW TO TAPER BACK AS SHOWN. ANY BURRS OR ROUGH EDGES MUST BE POLISHED OFF OR HONED AWAY TO PRODUCE A SMOOTH WRITING TIP.

Fig. 5. V-type metal pen

Best results are obtained with V-type pens if the tip is adjusted to write a fine clear line and not allow ink to flow too freely. Such a record is not only clearer but dries faster, minimizes blotting

when rerolled and makes less frequent filling of the relatively small pen reservoir.

4. Paper speed must be suitable for the character of record. A relatively steady load will produce legible records at low speeds such as ¾ or 1½ in. per hr. On the other hand a violently oscillating load must have a higher paper speed such as 3 or 6 in. per hr., not only to spread out the record to show variations, but to prevent the pen from writing in the same spot to the extent of soaking and wearing through the paper.

5. Ink should always be stored in bottles tightly corked. Paper at best is sensitive to humidity and spare charts should not be stored in a damp place. The absorption of moisture may cause considerable trouble with paper jamming due to expansion or contraction so that perforations do not tract driving pins and damp paper giving trouble with inking qualities.

A MOTOR IS SMOKING

An interesting study of the causes of 14 cases of smoking motors with suggestions for overcoming trouble of this nature. The most common cause of overheating of motors was single-phase operation

By HAROLD B. PHILLIPS

AROUND FACTORIES and mills employing electric motor drives to any extent, a not uncommon message to reach the electric department is that some certain motor is "smoking". In one large plant a record was kept of fourteen successive reported cases covering a period of 18 mo., with the results given in the tabulation.

All motors were of the 3-phase 440-v. squirrel-cage or wound rotor induction type and ranged in size from ½ to 100 hp.

Heading the list comes the cases where motors had run single-phase, or where rotation had ceased, but line potential was still impressed on one set of coils, until the insulation of these coils had heated to the point of giving off a noticeable smoke and odor. In only one case was the injury to the insulation of such a serious nature that it broke down, requiring rewinding.

In motor circuits that are properly fused or protected by suitable relays there should be small chance of single-phase operation. However, where a motor is started by a compensator having overload relays for running protection it is universal practice to install the starting fuses large enough to preclude the possibility of their blowing under extremely hard starting conditions.

It is for this reason that the starting and stopping of all motors should be delegated only to competent and experienced workmen. The following is a case in point.

In this instance, which falls under heading (a) a workman had blocked the starting lever of the compensator to prevent its tripping out when the relays opened. The other case under (a) occurred where an old type compensator was provided with fuses for running protection in place of relays.

Two of these had been carelessly exchanged for fuses of too great capacity. Where overload relays are used for running protection this evil is of course eliminated but there are still a surprising number of old installations which depend on fuses only.

Under (b) was found a combination of bent contact finger, a trip lever that stuck when the relays opened, and too heavy line fuses.

Both motors involved under (c) and (d) were of small size, and were thrown directly across the line for starting, so that the starting fuses provided also for the running protection, and were necessarily of large capacity. In (d) the motor was in an overhead hoist with controller operated by ropes from the floor. A broken spring in controller failing to return contacts to neutral, allowed two sets to touch while motor was at rest.

When the rotor of a motor becomes displaced until it rubs on the stator, a dense smoke soon makes its appearance accompanied by extreme heating of coils and laminations near the point of contact. Of the three cases coming under this section two were due to improper assembly after the motor had been taken apart, and one to a poor job in rebabbitting a bearing.

Because of the very small clearance between the stator and rotor of an induction motor, a great deal can be said in regard to the necessary care in the babbitting of motor bearings. Only the best grade of babbitt obtainable should be used and it should never be remelted more than once for the purpose.

After the bearings are properly babbitted they should be bored out only by a careful and experienced machinist, otherwise the bearing is likely not to be properly centered in the lathe, or else bored to a sloppy fit inviting further trouble when it is put into service.

(Continued on page 83)

Record of Smoking Motors

Source of Smoke	Cause	Number Reported
Running single-phase	(a) Blown Fuse	2
	(b) Poor contact in starting switch	1
	(c) Motor terminal broken at lug	1
	(d) Switch only partly withdrawn	1
Rotor rubbing	Rotor imperfectly centered	2
	Worn bearing	1
Hot water bearing	Bearing dry	1
	Drive chain too tight	1
External source	Belt slipping on pulley	2
Motor burned out	Cause undetermined	1
	Oil soaked coils	1

Dew Point of Flue Gases of Fuels Containing Sulfur

By JESSE S. YEAW and LOUIS SHNIDMAN
Rochester Gas & Electric Corp.
Rochester, N. Y.

New developments and refinement of old processes bring new problems. In the early years of power development the question of dew point of flue gases was of no particular interest to the boiler plant designer or operator; the temperature of the stack gases, as a rule was sufficiently high so that condensation of flue products did not occur. With improved design and control of boiler equipment, however, and the tendency to reduce both excess air and flue temperatures, the dew point of the flue gases has become a serious problem and as the authors of this article indicate, must be considered in the design of the equipment. In view of these facts we are pleased to be able to present this article on the subject by Messrs. Yeaw and Shnidman, both of the Rochester Gas & Electric Corp. The authors are graduate chemists who have been associated in the laboratories of the Rochester Gas & Electric Corp. for the past 15 yr. Since the business of their company is to sell city gas, electricity and steam they have had opportunities to work with a variety of field conditions and it was inevitable that they should have become interested in the combustion of fuels. We feel that they have done an excellent job in preparing this paper and the data in it should be of value both to designers and operators of modern boiler equipment. This is the first part of a three part article on the subject. The other parts will appear subsequently

THE PRINCIPAL constituents of the flue products, resulting from the combustion of industrial fuels with air, are carbon dioxide, nitrogen, oxygen and water vapor. Small amounts of the oxides of sulfur and nitrogen are also sometimes reported. As these gases are cooled, a temperature is finally reached at which condensation occurs. This temperature is the point at which the vapor phase is in equilibrium with a minute quantity of the liquid phase, and it is commonly referred to as the 'dew point'.

Information relative to the dew points of flue gases has become important in industry due to the increasing use of fuel oil and gas in place of coal, and also due to the improvement in the design and control of equipment to obtain the maximum recovery of available heat.

The result has been to reduce both the excess air and the flue temperatures, and the matter of condensation in the flues, economizers, preheaters, etc., has become a serious problem which must be considered in the design and installation of the equipment[9].

This problem is complicated by the fact that the condensates precipitated at the dew point exhibit a surprising activity with respect to the corrosion of surfaces with which they come into contact, for they contain not only moisture, but also oxygen and the acidic oxide gases of carbon, sulfur, and nitrogen.

It is the purpose of this paper to show how the dew points of the flue products resulting from the combustion of sulfur bearing industrial fuels with varying amounts of excess air may be rapidly estimated.

Theoretical Dew Point

The theoretical dew point is calculated by assuming that the flue gas consists of a mixture of water vapor and an inert gas. The results are, therefore, based upon the vapor pressure data for water. The quantity of water vapor in the flue gas may either be determined directly or be calculated from the chemical equations involved in the complete oxidation of the fuel.

To this is added a quantity brought into the flues in the fuel itself, in the air used up in the theoretical combustion of the fuel, and in the excess air supplied. The results are fitted into a vapor pressure table for water or they may be plotted on a chart such as Fig. 1, which was obtained from the vapor pressure data for water.[6]

The simple chemical equations which express the oxidation of the

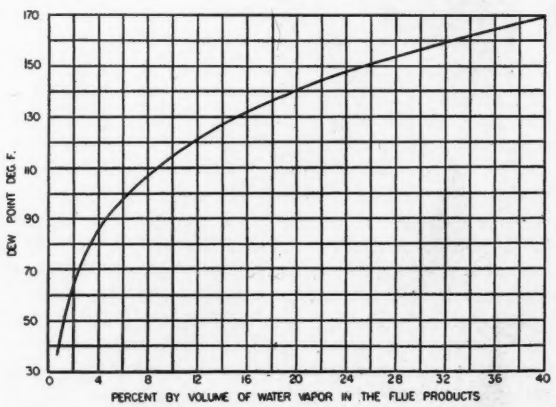


Fig. 1. Curve showing the relation of the amount of water vapor in flue gases to the dew point

EDITOR'S NOTE: Footnote figures refer to a list of references which may be found on page 71.

various combustible constituents of industrial fuels are:

$$C + O_2 \rightarrow CO_2$$
$$S + O_2 \rightarrow SO_2$$
$$H_2 + \tfrac{1}{2} O_2 \rightarrow H_2O$$
$$CO + \tfrac{1}{2} O_2 \rightarrow CO_2$$
$$CH_4 + 2 O_2 \rightarrow CO_2 + 2H_2O$$
$$C_2H_6 + 3\tfrac{1}{2} O_2 \rightarrow 2CO_2 + 3H_2O$$
$$C_2H_4 + 3 O_2 \rightarrow 2CO_2 + 2H_2O$$
$$C_6H_6 + 7\tfrac{1}{2} O_2 \rightarrow 6CO_2 + 3H_2O$$

The combustion data for gases, the analyses for which are generally given on a volume basis, are calculated directly from the chemical equations involved, by assuming that these equations express true volume relationships.

Table I shows a sample calculation for a complex manufactured gas mixture.

The combustion data for solid and liquid fuels, the analyses for which are generally given on a weight basis, are likewise calculated from the chemical equations and converted to the volume basis at 30 in. Hg. and 60 deg. F. by the use of the averaged pound mol volume, 378.4 cu. ft. Thus:

1 lb. C forms 378.4/12 = 31.53 cu. ft. CO_2, also equals the O_2 required.

1 lb. H_2 forms 378.4/2 = 189.20 cu. ft. of H_2O, O_2 required equals ½ of this.

1 lb. S forms 378.4/32 = 11.83 cu. ft. of SO_2, also equals the O_2 required.

1 lb. N_2 has a volume of 378.4/28 = 13.52 cu. ft.

1 lb. O_2 has a volume of 378.4/32 = 11.83 cu. ft.

1 lb. H_2O has a volume of 378.4/18.02 = 21.00 cu. ft.

The nitrogen introduced with the oxygen of the air is equal to 79/21 or 3.76 times the volume of O_2 required for the combustion. In all of the calculated results given in subsequent parts of this paper, it has been assumed that all of the air used in the combustion and as excess air was 50 per cent saturated at 60 deg. F., i.e., 0.87 per cent H_2O by volume. The data on Table II shows the calculations for a sample of steam coal.

Table I. Sample Calculation of Dew Point for Gaseous Fuel

(Volume Basis)

Fuel Analysis Per cent by volume Mfd. Gas		Cu. ft. per cu. ft. of Gas Burned Req. for Comb. O_2	Air	Products of Combustion CO_2	H_2O	N_2	SO_2
H_2	45.98	.230	1.095	...	.460	.865	
CO	11.79	.059	.281	.118	...	.222	
CH_4	25.26	.505	2.405	.252	.505	1.900	
C_2H_4	2.06	.062	.294	.041	.041	.232	
C_6H_6	1.38	.104	.493	.083	.041	.389	
Org. S	0.015	.00015	.0007	...	...	.0006	.00015
O_2	0.20	—.002	—.010	...	...	—.008	
CO_2	2.85	...	...	.029	...	...	
N_2	8.74	...	...	...	...	.087	
H_2O	1.73	...	...	...	.017	...	
Total	100.00	.958	4.559	.523	1.064	3.688	.00015

H_2O brought in by Req. Air (0.87%)* = .040 cu. ft.
Total Flue Products 5.315 cu. ft.† (wet basis), 4.211 cu. ft. (dry basis).
Total H_2O 1.064 + .040 = 1.104 cu. ft.
Per cent H_2O vapor in Flue Products 1.104/5.315 × 100 = 20.77.
Theoretical Dew Point from Fig. 1 = 142 deg. F.

*This figure as explained in the text is based on air, 50 per cent saturated, at 60 deg. F.
†This figure, it will be seen, is the sum of the CO_2 (523) + H_2O (1.064) + N_2 (3.688) + SO_2 (.00015) + the H_2O brought in by the req. air (.040).

Air-Fuel Mixtures

The dew points for the theoretical air-fuel mixtures for a large number of fuels were calculated, and it was found that these data, when plotted against the weight ratio $\frac{H_2}{C+S}$ fell along smooth curves in the cases of solid and liquid fuels.

In the case of the gaseous fuels these dew points varied with the calorific value of the fuel in terms of B.t.u. per cubic foot. These curves were plotted on the same chart with the curves representing the decrease in dew point with increase in excess air.

From this combined chart, Fig. 2, the dew points for the flue products of any ordinary fuel with any mixture of air may be readily estimated with an accuracy about equal to the expected deviation in reading such curves. This is sufficiently accurate for all ordinary practical considerations[13].

The dotted line on Fig. 2 represents the complete course of an estimation for a coal sample. The ultimate analysis of this sample was such that the $\frac{H_2}{S+C}$ weight ratio was 0.088. This value is plotted on the horizontal scale at the bottom of the chart as shown.

The dew point of the flue products of the theoretical air-fuel mixture is read off on the respective labeled curve (solid fuel curve in this case) and is 155 deg. F. This is the dew point of the air-fuel mixture with no excess air.

If we assume that the fuel was being burned with about 125 per cent excess air (or about 57 per cent of air in the flue gas), then the dew point of this flue gas mixture would be somewhat less than 115 deg. F. In order to find the dew point of this mixture, the proper curve is followed downward to the right from 115 deg. F., as shown by the course of the dotted line, until a point at the flue dilution of 125 per cent excess air or 57 per cent air in the flue products is reached.

The final theoretical dew point of the flue gas and excess air mixture is again located on the dew point scale at the left, and is equal

Table II. Sample Calculation of Theoretical Dew Point for Solid Fuel

(Weight Basis)

Fuel Analysis Per cent by Weight Bit. Steam Coal B.t.u./lb.= 13900		Cu. ft. per Pound of Fuel Burned Req. for Comb. O_2	Air	Products of Combustion CO_2	H_2O	N_2	SO_2
Carbon	77.85	24.55	116.86	24.55	...	92.31	
Hydrogen	4.96	4.69	22.32	....	9.38	17.63	
Sulfur	1.00	.12	.57	....	...	.45	.118
Oxygen	5.87	—.69	—3.28	....	...	—2.59	
Nitrogen	1.54	....	....	....	...	0.21	
Moisture	2.44	....	....	....	.51	....	
Ash	6.34	....	....	....	...	....	
Total	100.00	28.67	136.47	24.55	9.89	108.01	.118

H_2O brought in by Required Air (0.87 per cent) = 1.19 cu. ft. vapor.
Total H_2O = 9.89 + 1.19 = 11.08 cu. ft. vapor.
Total Flue Products = 143.76 cu. ft. (wet basis) or 132.68 cu. ft. (dry basis).
Per cent H_2O vapor in Flue Products 11.08/143.76 × 100 = 7.71 per cent.
Theoretical Dew Point from Fig. 1 = 106 deg. F.

$$\frac{H_2}{C+S} = \frac{4.96}{77.85+1.00} = .063 \text{ Est. Dew Pt. Fig. 2} = 106 \text{ deg. F.}$$

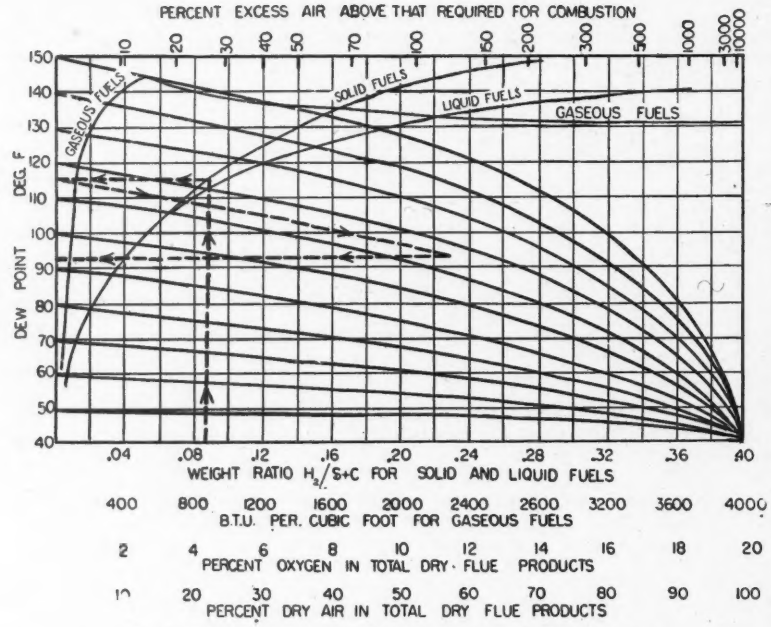

PERCENT EXCESS AIR ABOVE THAT REQUIRED FOR COMBUSTION
10 20 30 40 50 70 100 150 200 300 500 1000 3000 10000
DEW POINT DEG. F
150 140 130 120 110 100 90 80 70 60 50 40
GASEOUS FUELS
SOLID FUELS
LIQUID FUELS
GASEOUS FUELS
.04 .08 .12 .16 .20 .24 .28 .32 .36 .40
WEIGHT RATIO H2/S+C FOR SOLID AND LIQUID FUELS
400 800 1200 1600 2000 2400 2600 3200 3600 4000
B.T.U. PER CUBIC FOOT FOR GASEOUS FUELS
2 4 6 8 10 12 14 16 18 20
PERCENT OXYGEN IN TOTAL DRY FLUE PRODUCTS
10 20 30 40 50 60 70 80 90 100
PERCENT DRY AIR IN TOTAL DRY FLUE PRODUCTS

Fig. 2. Theoretical dew points of the products of industrial fuels

to 93 deg. F. in the case illustrated on Fig. 2.

A similar procedure is followed in the case of the gaseous fuels except that the calorific value in terms of B.t.u. per cubic foot of the gas is first plotted instead of the $\frac{H_2}{C+S}$ weight ratio.

The theoretical quantity of air required for the complete combustion of the fuel and of the volume of the flue products resulting from this combustion may be roughly estimated from the calorific value of the fuel. The average factors necessary for this calculation are listed in Table III, together with the approximate accuracy and the exceptions.

Condensation of Water from Flue Gases

At the dew point only a minute trace of water is condensed. As the flue gas is cooled below this point, an increasing fraction of the vapor condenses. This fraction of the total vapor thus condensed may be calculated by the use of Fig. 1, thus:

Per cent of total vapor condensed at t°

$$= 100 - \frac{\text{Curve reading at t°}}{\text{Fraction of water vapor in flue products.}}$$

It is obvious that this formula is applicable only when the whole body of flue gas is brought to a constant temperature. Actually this is rarely the case in practice. Thus, in economizers, preheaters, flue pipes, etc., there is a sharp temperature gradient near the walls, and condensation occurs even when the flue temperatures are far above their theoretical dew points.[5, 8]

Table III. Approximation of Theoretical Air Required and the Volume of the Resulting Flue Products

		Approx. Per cent Accuracy	
	Cu. ft./lb. of Solid Fuel		
Theoretical air required	B.t.u./lb. × 0.0097	3	Fuels containing
Total flue products	B.t.u./lb. × 0.0106	3	more than 30 per cent
Total water in flue products	B.t.u./lb. × 0.0008	50	moisture
	Cu. ft./lb. of Liquid Fuel		
Theoretical air required	B.t.u./lb. × 0.0094	3	Results low for
Total flue products	B.t.u./lb. × 0.0099	3	gasoline and
Total water in flue products	B.t.u./lb. × 0.0010	20	kerosene
	Cu. ft./cu. ft. of Gaseous Fuel		
Theoretical air required	B.t.u./cu. ft. × 0.0089	5	
Total flue products	B.t.u./cu. ft. × 0.0104	5	Gases of 300 B.t.u.
Total water in flue products	B.t.u./cu. ft. × 0.0020	10	per cu. ft. or less

The dew point has been defined as the temperature at which the vapor phase is in equilibrium with a minute quantity of the liquid phase in any system.

In a complex system such as flue gas which contains a comparatively large fraction of water vapor together with a variety of soluble gases, a number of chemical combinations are possible.

A survey of the solubility and vapor pressure data for these possible compounds shows, however, that, for all practical purposes, the effect upon the dew point of all the vapors in flue gases except water and sulphuric acid may be neglected except in so far as they act as inert substances in diluting the vapor volume.

That the effect of the presence of SO_3 in flue gas upon its dew point is considerable has been proved repeatedly. Johnstone[4] showed that a difference of 0.008 per cent SO_3 caused an increase of 124 deg. F. in the dew point. Voight and Hohberg[11], showed that the addition of 0.001 to .006 per cent SO_3 raised the dew point 50 to 170 deg. F. Maconachie[7] using a manufactured gas containing 12 grains of sulfur per 100 cu. ft. showed that when burned with 66 per cent excess air the SO_3 content of the flue gases was 0.0004 per cent and the dew point was increased from 122 to 158 deg. F. or 36 deg.

The authors[12] determined the dew points of the flue gases resulting from the combustion of a manufactured gas containing 9 grains of sulfur per 100 cu. ft. with various amounts of excess air, and found that the dew point of the theoretical mixture was increased 18 deg. F. from 141 deg. F. due to the presence of the sulfur.

It will be clear from this brief summary that the deviation of the dew point from the theoretical by reason of the presence of sulfur trioxide in flue gases must be taken into account.

Calculation of the True Dew Point of Industrial Flue Gases

Whereas the vapor pressure data for water has been accurately determined and are generally available[6], the necessary vapor pressure data for dilute sulphuric acid solutions are not. An estimation of the effect of H_2SO_4 (SO_3) upon the dew point is rendered still more difficult by the lack of a satisfactory method for the analysis of flue gas mixtures for traces of SO_3 (1 to 100 parts per million) in the pres-

ence of several times as much SO_2.

Johnstone[4] has suggested a graphical method, based upon the limited amount of data available, by means of which the dew points of gases containing SO_3 might be indicated. Such a chart is shown in Fig. 3.

The data shown by the points indicated were obtained from results presented by Thomas and Barker[10], Barclay[1], and the International Critical Tables[3]. Extrapolations of these data are indicated by the o marks.

Briefly, the curves slanting downward to the left on Fig. 3 are the projections of the logs of the concentrations of SO_3 in the $H_2O + SO_3$ mixtures, plotted against the log of the increase in the proportion of H_2O in this mixture, expressed as partial pressure of H_2O vapor in the flue products in mm. Hg., and labeled per cent SO_3 by volume in the original dry flue gas.

For each point on these curves there is a temperature at which a dilute sulphuric acid solution begins to condense. This temperature represents the boiling point of the acid solution which condenses, and it is, therefore, the true dew point of the mixture.

These data are represented on Fig. 3 by the lines which slant downward to the right. These lines were drawn straight and as nearly as possible through the points representing experimental results or extrapolations of them. They were extended downward to the slant line at the right which represents the dew points due to water vapor alone. At this point a concentration of SO_3 equal to about 1.6 p.p.m. still exists in the system. It must be assumed that any concentration of SO_3 below this amount does not affect the dew point of a mixture due to H_2O alone, while any concentration of SO_3 above this amount will.

Since the partial pressure of H_2SO_4 vapor in flue gases is always very small, it may be neglected in estimating the sum of the partial pressures of the acid and the water vapor. Thus, in any specific case, the partial pressure of water alone may be assumed to be equal to the sum of the partial pressures of sulphuric acid vapor and water vapor in the flue gas.

The partial pressure in terms of mm. Hg. is obtained from the total pressure on the system expressed in mm. Hg. by multiplying by the fraction of water vapor calculated to be in the mixture. Thus, in a flue gas mixture with

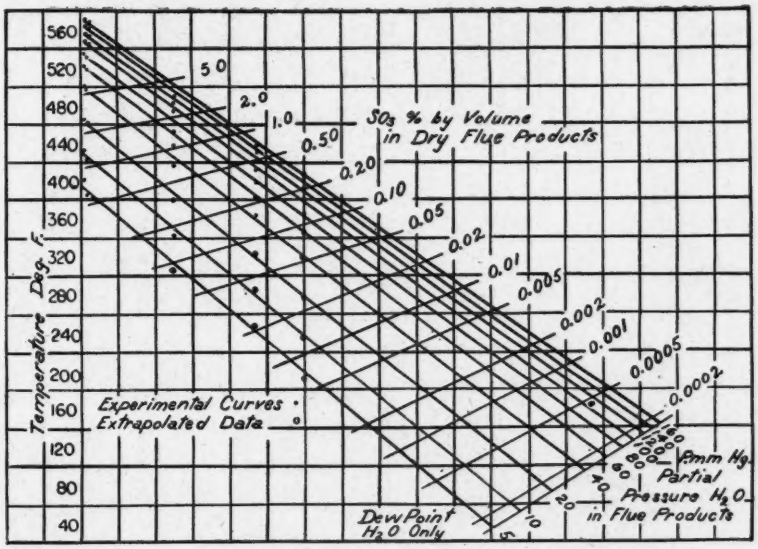


Fig. 3. Dew points for dilute mixtures of sulfur trioxide

10.5 per cent H_2O, the partial pressure of the water vapor is 10.5 per cent of 760 mm. (atmospheric) or 80 mm. Hg.

The total pressure on the flue gas system may not be exactly one atmosphere, in which case the corrected pressure in terms of millimeters should be obtained and used in this calculation.

The chart shown in Fig. 3 represents graphically the relation between the SO_3 concentration expressed as per cent of the dry flue gas, the sum of the partial pressures of H_2O and H_2SO_4 in the vapor state (H_2O only in most cases), and the true dew point of the flue gas mixture. By the use of the chart, therefore, any one of the three values can be estimated if the other two are known or can be found.

For example, a flue gas has been analyzed and found to contain 0.001 per cent SO_3 by volume (dry basis). The partial pressure of H_2O, as calculated from the theoretical combustion, was 80 mm. Hg. The dew point of this mixture would be 187 deg. F. If the effect of the SO_3 had been neglected, the dew point would have been 117 deg. F. (Fig. 1 or Fig. 3).

EDITOR'S NOTE: This is the first part of Messrs. Yeaw and Schnidman's treatise on the determination of dew point. The second part, dealing with the estimation of sulfur trioxide in flue gas will appear in the February issue.

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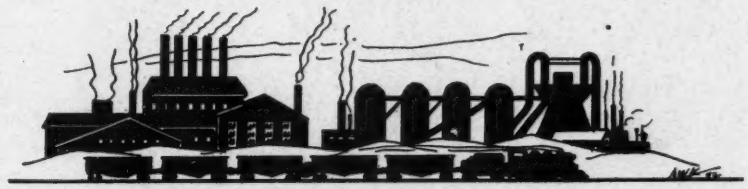
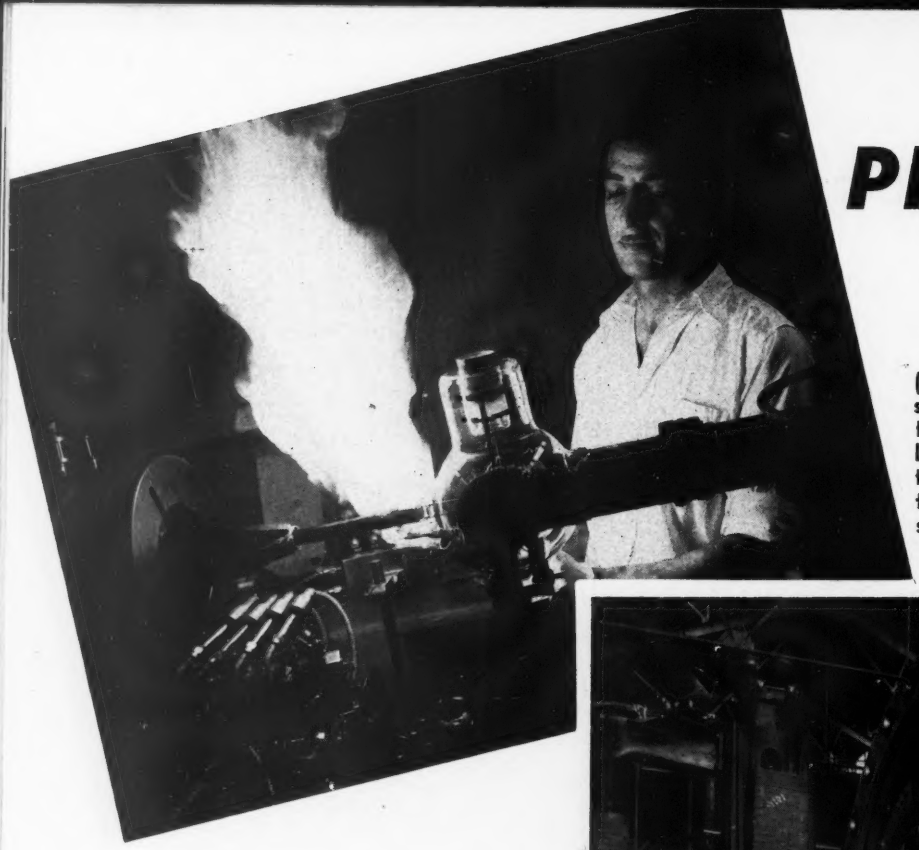
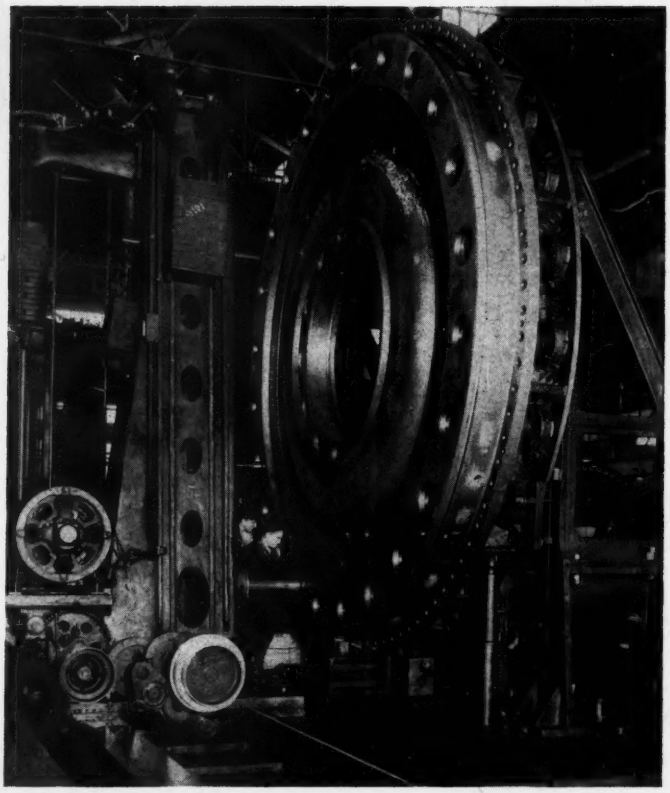


PICTURES



(Below) Finishing operations on the speed ring of a large hydraulic turbine in the shops of the Baldwin Locomotive Works. Work such as this not only requires large special types of machinery but also highly skilled workmen to do the work

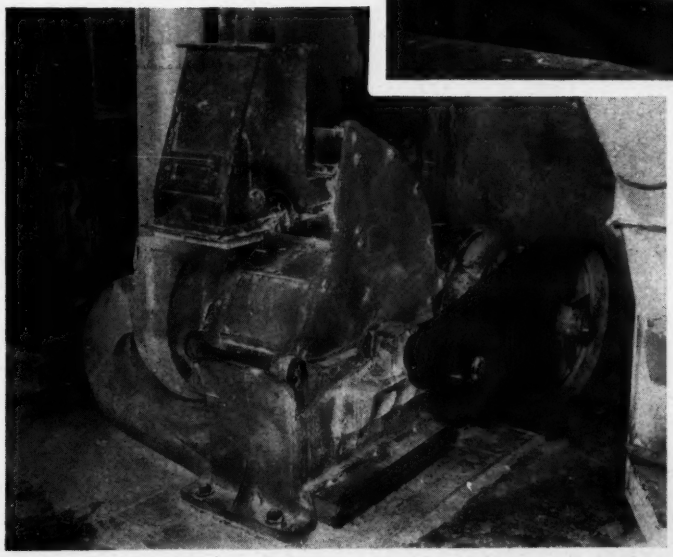


(Above) Flame thrower on the production front. Sealing the end of a high power radio transmitting tube is done at the Westinghouse Lamp Division by this cannon burner. As the big tube rotates on a lathe the gas flame of more than 1000 deg. F. melts the end of the glass bulb to make an air-tight seal. Manufacture of such tubes has been greatly accelerated because of warfare communication

(Left) Mercury siphoned into bottles is made 99.99995 per cent pure in this General Electric purification plant. The mercury is required for reliable operation of electronic tubes providing power for war industries in the manufacture of aluminum and magnesium. A hundredth of one per cent of impurity in the mercury would make the tubes fail. Mercury vapor is also poisonous and every precaution is taken to safeguard the health of the men working in this plant. An electronic detector gives an immediate warning if the concentration of mercury vapor in the air should begin to increase toward dangerous proportions

# of Engineering Interest

(Right) The Spencer Heater Div., Aviation Corp., Williamsport, Pa., which has converted 100 per cent to war work, is devoting a considerable part of its capacity to the production of steel-fabricated units for the country's fast-expanding merchant fleet. Shown here in the boiler shop, along with steel tubular boilers for the Army cantonments and new war plants, are ship stacks and above-deck houses



(Left) Operating under extremely severe service conditions, unusual performance has been set by eight multi-V-belts in the Finger Lakes & Hudson Flour Mills, Inc., flour mill in Troy, N. Y. The drive was designed to operate a 25-hp. Schutte Hammermill flour grinder, and has been running 16 hr. per day continuously since June, 1940, without a breakdown. The belts run at a speed of over 6900 f.p.m., while the motor runs at 1200 r.p.m. The motor sheave is 22 in., and the belts drive a 7.6-in. eight-groove sheave

(Right) Concrete cast against the new Hydron form linings, developed by the United States Rubber Co., is several times as resistant to weather and abrasion as ordinary concrete. Here the fabric facing is peeled from the concrete, after the forms have been removed, leaving a surface which is smooth and attractive in appearance without any added refinishing

Steps for the protection of power sources have come a great distance since thought was first given to the subject. Outlined here are some of the means used by the Commonwealth Edison Co., Chicago, Ill., for maintaining industrial power for its customer use in the war effort. The plan as it is given deals with all contingencies and goes to great length in order to avoid mishaps from any cause

Commonwealth Edison Trains Protection Organization

BEARING the Edison Service emblem of the Commonwealth Edison Co., and commonplace to the average Chicagoan, a fleet of green sedans, each equipped for two-way radio communication and manned by uniformed guards, a 24-hr. watch is kept over Chicago's electric supply system, protecting it from sabotage.

These radio patrols are merely a visible manifestation of a carefully planned campaign for protection that had its origin more than a year ago to combat any possibility of what might happen under wartime conditions and interrupt service that is essential to the war effort.

The protection organization is divided into two distinct units, a growing force of uniformed special police doing patrol and watch service, and a volunteer defense corps used as an auxiliary unit to supplement the first group. The auxiliary group was formed from the Commonwealth Edison Post of the American Legion.

The radio patrol cars cover beats close to major electric production, and while their appearance at a given location cannot be anticipated, a 'flash' from the central radio operator will bring one to any location on its beat in a matter of minutes. All members of the radio patrol are licensed operators, and the contacts with the central office are conducted in verbal code on a frequency that is above the top range of the average household receiving set.

It might be added here that the radio devices used are adapted for the special needs of the company, and that the advanced type of F-M system employed furnishes excellent reception of the spoken word in two-way communication.

Fig. 1. The two-way radio equipped cars cover the beat

The employes engaged in anti-sabotage work are deputized by the Chicago Police Department, which is acting in close cooperation, and a radio tie is maintained between the Chicago station and the Illinois State Police. As an additional safeguard for company property, heavy wire fences surround the generating stations, and nightly illumination is provided for high-voltage switching structures and other major outdoor installations.

All persons working in or having business with power plants, substations and service buildings are required to wear identification badges, and escorts are provided for all outsiders who have occasion to enter the plants. Guards at the locked gates are within easy reach of telephones and alarms in any emergency.

Photographing is out for the duration, and persons found to have negatives are obliged to surrender them. Automobile license plates are noted, as are markings on airplanes. Posters by the company offer rewards for the conviction of persons attempting sabotage against its properties.

Intensive training has been given to all employes at the vital locations of the company in case of air raids, and the plants are equipped with all the necessary pumps, hose, water, and other devices for combatting incendiary bombs and fire. Should the need become imminent for the services of an air raid crew, the Post Defense Corps would be called into action, since it has now a membership of nearly 1200 men.

In equipping the corps, the unpredictable was planned for and members were given both class room work and practical application of the theories of adequate protection. Included in the mobile equipment assigned to the corps are eight delivery trucks that have been rebuilt to serve as ambulances, and four that have been converted to mobile field kitchens. Six auxiliary fire pump trucks have also been provided.

The drill school covered fires and fire hazards, types of extinguishers, the use of gas masks, and fire control and the means of extinguishing and combatting incendiary bombs. Drills were conducted at the Chicago Fire Department drill school, where the men were familiarized with hose and nozzle equipment, operation of ladders, fire line hitches and the various phases of fire-fighting.

Class work for auxiliary police was conducted by the company's plant protection staff. Lecture work included the duties of a special patrolman, theft prevention, legal terms and their meanings, note taking, report writing, portrait parle and description, and technique of arrest and search.

After passing written examinations, men who showed qualifications for the work were moved into an advanced group where a knowledge of the use of firearms was gained. Emphasis was placed on triangulation, sighting, trigger-squeeze, stance and grip. Target shooting and silhouette shooting have been included in the training.

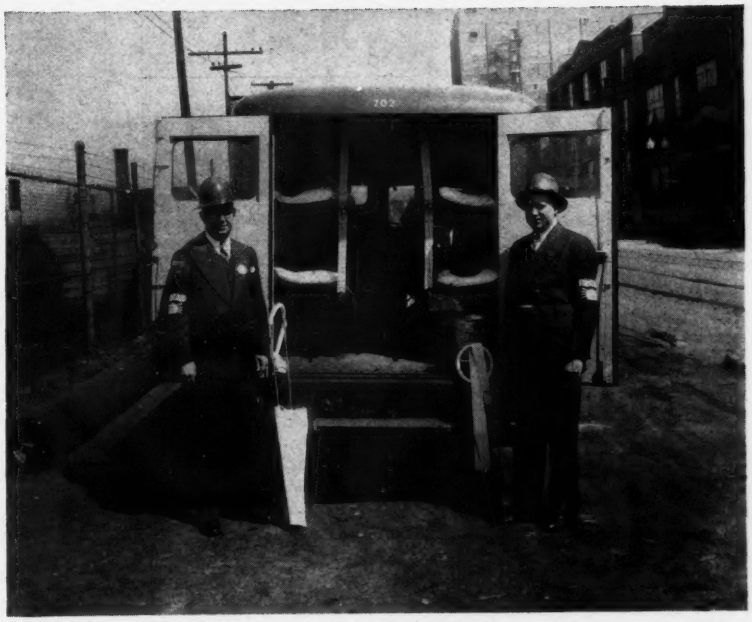


Fig. 2. One of the ambulances ready for action

The members of the corps who have been assigned to first-aid work have taken the American Red Cross standard and advanced courses and have also received training in the identification and treatment of war gases and rescue work. In the eventuality that a company plant is bombed these men would immediately take over the task of extricating the injured and treating wounds. This would release the construction forces for the task of restoring electric service.

The personal equipment that a first aid man has includes a specially designed belt containing necessary supplies, a flashlight for use in blackouts, a lip stick for marking the forehead of a wounded person with the proper symbols to designate what treatment has been given, and paper and pencils for recording statements of the injured and keeping first aid records.

The four ambulances carry portable field dressing stations. These tents and their equipment would be set up near the scene of activity for the use of company doctors and nurses, in the event that no suitable building or shelter were available.

Practices or rehearsals have been held to assure the proper coordination of all activities, and simulated conditions have indicated that the corps is well trained and responsive to every regulation that has been prescribed.

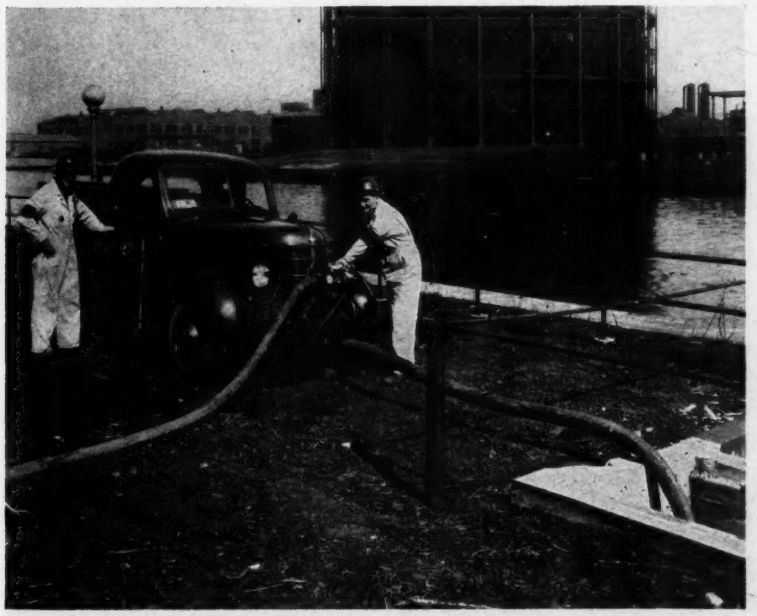


Fig. 3. Fire pumps are manned by trained experts

Unions and industries should work cooperative training courses for tradesmen and engineers.

* * *

When you trade a dollar for a dollar you add nothing to your wealth, trade an idea for an idea and you gain one hundred per cent by the bargain, trade a hope for a hope and all humanity benefits.

Small Plants Need Good Engineering Too

Hospital plant built with limited funds in cold climate makes use of section of uncovered breeching as an air heater. Engineers' plans included detailed drawing of both piping systems to facilitate preparation of bids

by **E. R. LITTLE**, The E. R. Little Co., Detroit, Mich.

AT NEWBERRY, Mich., the temperature often drops below minus 20 deg. F. and occasionally to minus 40 deg. In the power house that supplied heat, light and water to the Newberry State Hospital for many years previous to 1939, the combustion air was taken directly from the outside.

The chief operating engineer was greatly astonished one extremely cold snowy night, when this below zero air combined with snow and drippings from wet coal in the stoker hopper, to form enough ice on the stoker mechanism to literally freeze it.

When the new power plant was designed the above condition was given attention and an endeavor made to avoid similar happenings. However, the situation was complicated by the fact that the funds available for the project were so limited that a conventional type of air preheater was out.

A rather simple solution of the problem was devised and incorporated into the plant design. After two winters of operation it has proven its merit. Figure 1 shows the method used. The combustion air enters through screened louvers in four sides of a small penthouse on the power house roof.

A 7 ft. by 7 ft. metal duct connected this penthouse with one end of a metal housing which surrounds the unlined main boiler breeching. The housing is so installed that there is approximately 1 ft. between it and the breeching walls, and it extends, in a lateral direction, a distance of 20 ft. where a duct connects with the fan room located at the boiler room floor level. From the fans the air is discharged into an under floor concrete duct, which extends to the stoker wind boxes.

As expected, the temperature of the air is raised approximately 70 deg. F. by passing through this breeching enclosure, and there are no evidences of either condensation or impairment of the draft from the 150 ft. chimney.

The Newberry plant consists of two Wickes 600-hp. boilers fired by Detroit underfeed stokers. The steam produced is used for heating the hospital buildings and generating all the electric power used by the institution. The generating equipment consists of one 300 and one 500-kw. Worthington-Moore turbines, driving Crocker-Wheeler 2300-v. generators. The turbines operate at a throttle pressure of 150 lb., saturated, and exhaust at 5 lb. gage to the heating system.

In the preparation of plans for this power plant, the engineers did not stop when the usual floor plans, cross section and details were made, but also provided the bidders with a diagram of the entire steam and water piping systems showing all

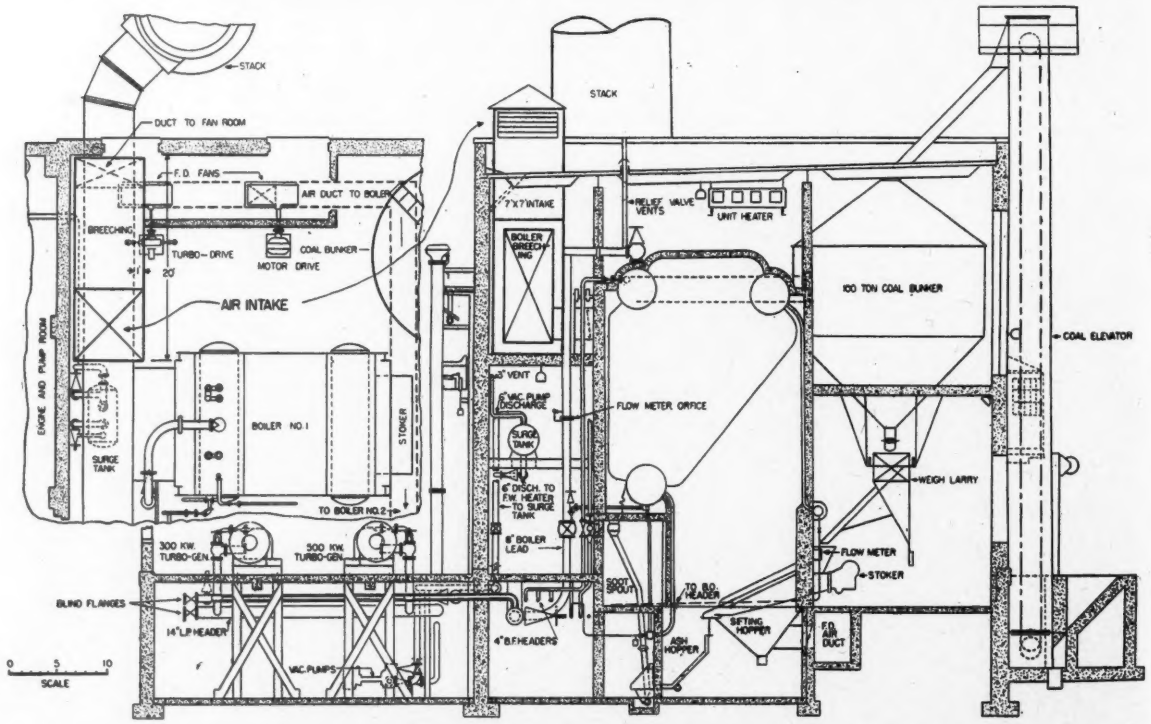


Fig 1. Cross section of the Newberry State Hospital plant showing the general arrangement. The air intake or pent house is shown in heavy lines. Air for combustion sweeps over the breeching (see plan in upper left hand corner) for about 20 ft. and then passes down to the fan room. The air temperature is thus raised about 70 deg. F.

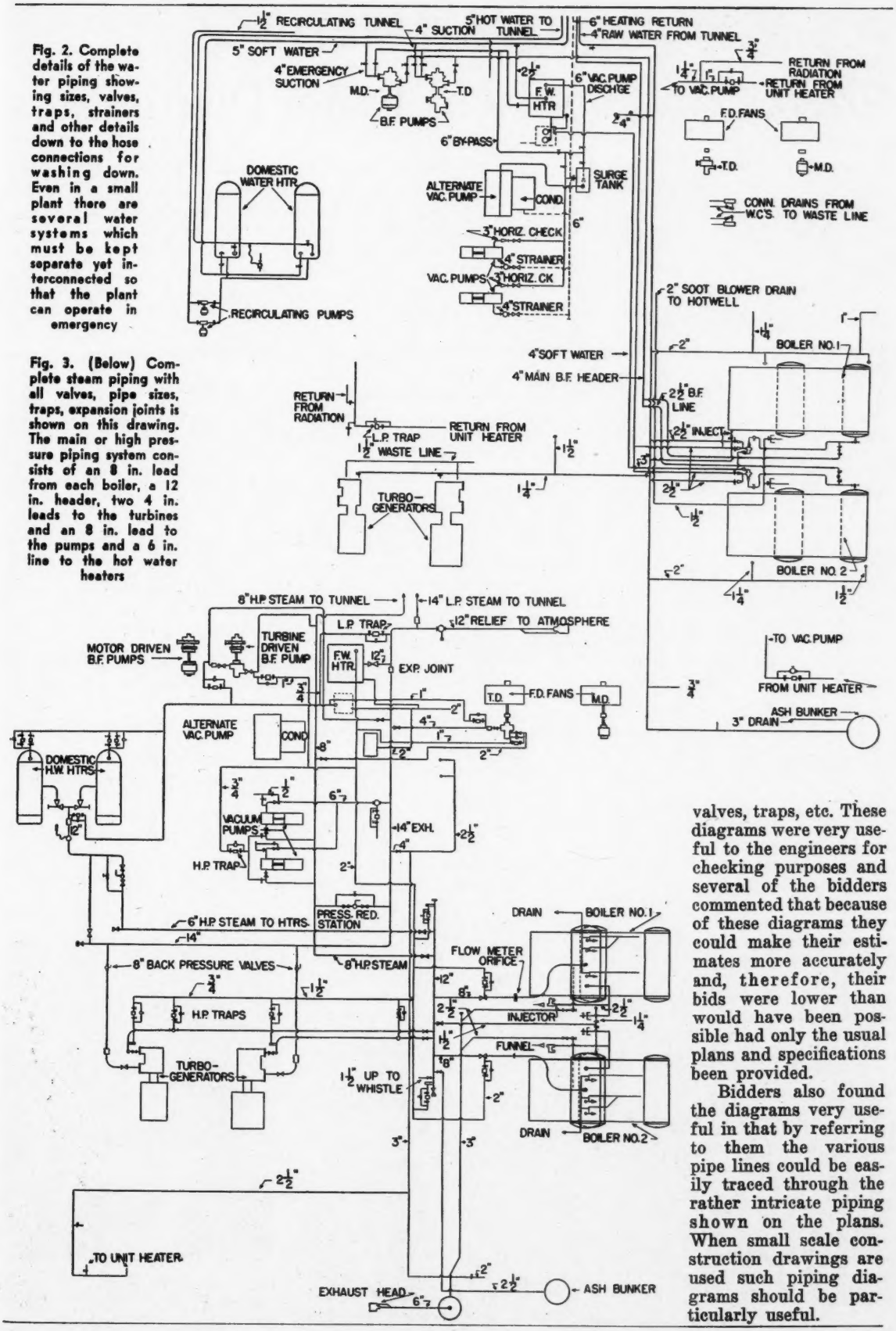


Fig. 2. Complete details of the water piping showing sizes, valves, traps, strainers and other details down to the hose connections for washing down. Even in a small plant there are several water systems which must be kept separate yet interconnected so that the plant can operate in emergency

Fig. 3. (Below) Complete steam piping with all valves, pipe sizes, traps, expansion joints is shown on this drawing. The main or high pressure piping system consists of an 8 in. lead from each boiler, a 12 in. header, two 4 in. leads to the turbines and an 8 in. lead to the pumps and a 6 in. line to the hot water heaters

valves, traps, etc. These diagrams were very useful to the engineers for checking purposes and several of the bidders commented that because of these diagrams they could make their estimates more accurately and, therefore, their bids were lower than would have been possible had only the usual plans and specifications been provided.

Bidders also found the diagrams very useful in that by referring to them the various pipe lines could be easily traced through the rather intricate piping shown on the plans. When small scale construction drawings are used such piping diagrams should be particularly useful.

A.S.M.E. ANNUAL MEETING Proves Popularity of Panel Discussions

By RALPH E. TURNER, Editor

At its sixty-third annual meeting, the A.S.M.E. gave first place to problems directly connected with winning the war. Sessions on human ingenuity, engineering education, manpower, aviation, industrial conservation, as well as the more technical branches of the profession such as boiler performance and construction, feedwater problems, wartime plant operation, prime movers and instrumentation filled the week from November 30 to December 4

ENGINEERS who attended the sixty-third annual meeting of the American Society of Mechanical Engineers held in Hotel Astor, New York City, on November 30 to December 4, sensed a great intensity of interest throughout the week, more than usual. Perhaps it was a feeling of responsibility on the part of the profession for production of more and better war materials. We would place that first, but along with that reason came the conduct of many of the sessions which were of the discussion type. No carefully prepared papers were preprinted for these sessions. Even the experts talked much of the time "off the record."

To get the full benefit of such a session you must be in attendance, for a complete report is not permissible. The large number registered, some 2800, also had its stimulating effects on the enthusiasm of the meeting.

Another definite reason for unusual interest was the increased number of sessions devoted to topics of human interest such as ingenuity, management, originality in young Americans, adaptability of workers, aviation, costs, production engineering, industrial training, and engineering educational programs.

NEW OFFICERS

President: Harold Vinton Coes.

Vice-Presidents: J. W. Eshelman, G. T. Shoemaker, T. E. Purcell, and W. J. Wohlenberg.

Managers: Roscoe W. Morton, A. R. Stevenson, Jr., and A. E. White.

James W. Parker in his presidential address under the title "The Spirit of a People" portrayed his impressions of the attitude of men of the engineering profession as he observed it during his extended travels during the past year. "The younger men in the student branches," he said, "are almost all of them affected by the war. Most of these engineering students expect shortly to be in the armed forces and they are puzzled to know whether or not they will be given opportunity to make use of their engineering training or will be able to resume that training after the war. Because of my belief that there will be great need in the future for men with a thorough training in the fundamentals of technology, I have urged these young men to finish their engineering education whenever circumstances permit."

For the most part members of the Society are deeply immersed in the war effort. They are pooling hitherto closely guarded methods and are aware of an impending social-economic change, of an internal debt of unimagined proportions, of the difficulties to be encountered in shifting back into peacetime pursuits, of the present expanded capacity of industry to produce war materiel, but they are confident that "the genius that made possible such a conversion of product for war will find means for shifting back to the ordinary uses of a world at peace."

"The question about which men's minds are puzzled is what kind of a world we shall be living in, what the incentives, what the opportunities. When changes come, as come they will, the country should this time have the benefit of the thinking that engineers can contribute."

In telling something of the duties, responsibilities and performances of the Ordnance Department of the Army, of which he is chief, Major General L. H. Campbell, Jr., stated that his first and uppermost responsibilities are to see that the fighting forces are equipped with the finest quality of weapons which can be produced by human ingenuity, and that such weapons are supplied in sufficient quantities and at the times and places desired. He reports that continuous improvements are being made and, although our commanding generals consider our weapons the finest, what we consider now as top flight may well be obsolescent at the end of the war if it lasts but a few years. He therefore recognizes the extreme need of research and development.

One of the first acts of the new

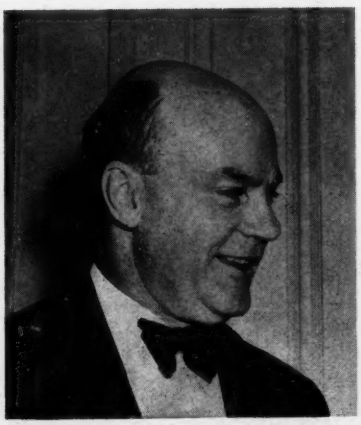


Fig. 1. James W. Parker whose term as president of the Society closed with this meeting

RECIPIENTS OF HONORS AND AWARDS

Winston M. Dudley, Junior Award.

John T. Rettaliata, Pi Tau Sigma Medal.

J. Kenneth Salisbury, Melville Medal.

Fred H. Colvin, Worcester Reed Warner Medal.

Ernest O. Lawrence, Holley Medal.

E. G. Bailey, A.S.M.E. Medal.

Arno C. Fieldner, Melchett Medal (Presented for the Institute of Fuels of Great Britain).

Honorary Memberships to: William L. Batt, Willis H. Carrier, Charles E. Ferris, Jerome C. Hunsaker, and Harry R. Ricardo.

president of the Society, Harold V. Coes, was to have the Council of the A.S.M.E. formulate and send a telegram to Paul V. McNutt, chairman of the War Manpower Commission, and to General Lewis B. Hershey, director of Selective Service, setting forth the extreme need for technically trained engineers in the armed forces, in war industries and in the rehabilitation program following the war, and suggesting that these needs can best be met through the deferment of certain students in engineering colleges.

Forced-Circulation Boiler Performance

During the past year the first forced-circulation boiler built in this country for 1825 psi, 960 deg. F. and with a continuous steam generating capacity of 1,000,000 lb. per hr., has been put into operation, and while no official tests have been run, F. S. Clark, F. H. Rosencrants and W. H. Armacost presented performance data which indicate close adherence to the designers' anticipated values. (See Fig. 4)

The observed performance reveals, according to the authors, that the proportions of all elements of the heat-absorption equipment and also the capacity of forced and induced draft fans are on the generous side; also that the range of control provided permits regulation of important temperature values to the anticipated performance with some margin to spare. The period of operation has not been long enough to give assurance that all operating difficulties have been overcome but, thus far, troubles which have arisen have not been such as to cause concern for the future.

Details of Boiler Construction

Work done in the laboratory and shop aimed at perfecting tube expanding methods in the construction of boilers was described in three papers whose preparation was sponsored by The Babcock & Wilcox Co.

One paper described an experimental investigation of tube expanding carried on to determine the fundamentals involved in tube expanding, the various practical methods of measuring the degree of expansion, the optimum degree of expanding and the ultimate strengths of expanded joints under various conditions of service. This investigation resulted in the finding of a characteristic variation in seat pressure on the tube, with degree of expansion. The seat pressure rises rapidly with increase in degree of expansion to a sharply peaked maximum, then falls off equally rapidly to a limiting value which is nearly constant.

The second paper dealt with the holding power and hydraulic tightness of expanded tube joints and presented an analysis of the stress and deformation. In the third paper the author discussed the practical aspects of making joints dealing particularly with the application of recent tube-expanding equipment and methods largely developed by Babcock & Wilcox.

It was stated that three basic tools are used for producing expanded joints from which all others are derived, the roll, the prosser, and the ball-drift expander. Only since 1940, when a new expander was developed, have the weaknesses of the standard expander been overcome, making possible the expanding of tubes in seats of unlimited width.

Careful investigation of metals used in boilers has also been going on and reports were presented at this meeting. One series of tests was conducted at Purdue University to determine the relative resistance to corrosion by steam of unstressed specimens of various alloy steels at temperatures of 1500 and 1800 deg. F. The results indicated that the

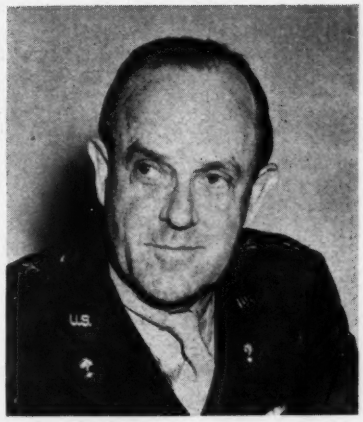


Fig. 2. Major General Levin H. Campbell, Jr., Chief of Ordnance of the U. S. Army, who addressed the A.S.M.E. at the annual dinner

25-20 and 25-15-2W steels were extremely resistant to steam corrosion for exposures up to 1300 hr., at 1800 deg. F., other steels tested corroded rapidly.

Another investigation conducted in the research laboratory of the United States Steel Corp. dealt with the effect of deoxidation practice on the creep strength of carbon-molybdenum steel at 850 and 1000 deg. F.

Boiler-Water Problems

Under the chairmanship of C. H. Fellows, of the Detroit Edison Co., a panel discussion on boiler water problems in connection with high-temperature, high-pressure steam generation was divided into four parts: 1. A review of the general problems encountered in high-temperature, high-pressure operation. 2. Boiler water scales, especially silicate scales. 3. Carryover. 4. Turbine blade deposits.

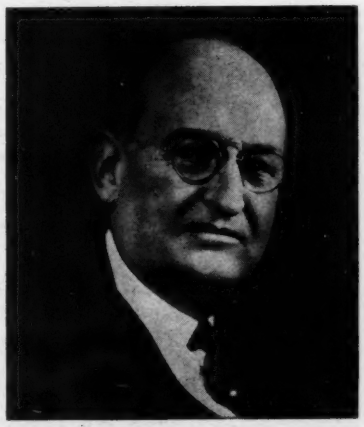


Fig. 3. Harold V. Coes, new president of the Society, assumed responsibilities of the office on Friday, December 4

The discussion made it evident that the boiler design, its circulation characteristics, construction details, metals used, provisions for washing steam, load carried, temperatures of water, steam, furnace and gases through the unit and height of water level, influence greatly the problems of boiler metal embrittlement, scale formation, carryover of impurities and deposition on turbine blades.

The character of the feedwater in its raw and treated states should, of course, receive first consideration. The changes in water characteristics that take place in the boiler during the process of steam generation must be studied and provisions made so to control them that concentrations of harmful solids do not take place nor, by geyser action, contaminate the steam leaving the boiler water surface to appear as scale in the superheater or harmful deposit on the turbine blades.

Failure to maintain the proper density of boiler waters, results not only in scale but carryover of solid particles with the steam into the superheaters and even into the steam lines giving trouble in turbines as deposits on the blades which today is reported as one of the most serious troubles encountered in steam power plant operation with cases so serious that as much as 15 per cent of the capacity of a turbine is lost between monthly cleanings.

To prevent corrosion, the boiler water must be kept well on the alkaline side but if too far on this side, the danger of caustic embrittlement is encountered. The exact pH value seems to be an individual problem depending to considerable extent upon the boiler design and its operating characteristics.

Some instances of copper deposits in pitted portions of boilers have been noted. The source of this copper being traced to decomposition of cuprous metals used in feedwater pumps, piping and gaskets. Some authorities do not consider copper as a factor in high-pressure, high-temperature boiler corrosion, but as "an accessory after the fact", not a cause of corrosion. The theory being that the copper deposits in the pit caused by some other water condition, but once deposited there the copper may, probably does, set up an electrolytic action which augments the corrosion.

Caustic embrittlement is not, it was pointed out, the only type of embrittlement encountered in boiler metals used in high-pressure, high-temperature boilers. There is quench cracking which sometimes occurs in tubes that are subjected to suddenly changing wet and dry conditions. Some of the newer metals employed become embrittled under heat and pressure strains. Portions of tubes at critical levels have shown embrittlement defects. Overheating is another cause. It was suggested that forced circulation may be the solution to some of these troubles.

Considerable difficulty exists in high-pressure, high-temperature plants with silicates and aluminates in various combinations with other elements, in various parts of the boilers themselves, in superheaters and on turbine blades. Boiler water treatment has been helpful when properly applied. Mechanical devices, such as steam scrubbers and separators, within the boiler drums, have been used with some success in preventing carryover to superheaters and farther along in the system.

One theory of silica carryover, now being investigated, is that some of the salts are soluble in steam and are thus carried over as vapor with the steam to become precipitated on the turbine blades situated in those areas where the pressures and temperatures are critical to the specific kind of silica salt.

This entire discussion brought out the fact that the various phases of the silica problem have just been formulated, not solved. Further advancement is sure to come as the solutions of various difficulties are attacked by specialists in the field.

Feedwater Heating Cycles

A panel discussion of the possibilities and limitations offered by the adoption of a more uniform steam extraction practice was conducted under the auspices of the Power Division with A. G. Christie as chairman.

Leaders in the discussion of feedwater heating cycles were representatives of turbine and boiler manufacturers, consulting engineers engaged in the design of power plants, and engineers representing operating companies who desired to secure the opinions of those present on the economic significance of difference in feedwater heating cycles and arrangements, particularly with reference to the question of whether some standardization could be effected.

Studies along this line were started by the National Defense Power Committee which submitted proposed standards for turbines for the consideration of the industry back in November, 1938. The object of the committee was to provide a means by which the industry could save time in securing turbine units, and reduce costs by simplifying design problems and standardizing manufacturing procedure.

While the discussion was focused upon the number and location of bleed points in an extraction turbine it soon became evident that this problem involves pressure, temperature and capacity conditions to which practically all equipment in the steam cycle is subjected—turbine, condenser, heaters, evaporator, pumps, economizer, air preheater, boiler proper and superheater.

Turbine manufacturers report that they can readily adopt the proposed extraction standards

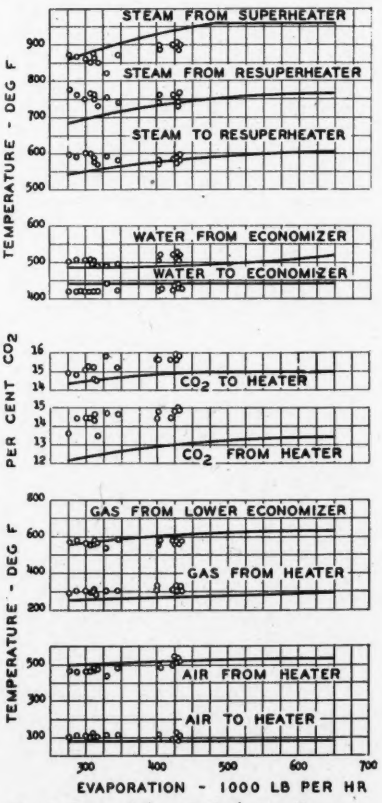


Fig. 4. Some of the principal operating conditions in forced-circulation boiler. Predicted results shown as curves compared with performance results spotted on chart

which would permit use of identical designs and cut down greatly on manufacturing costs encountered with special designs.

Boiler manufacturers recognize that feedwater temperatures are definitely affected by the number and location of bleed heaters but seem inclined to favor the proposed standards.

Consulting engineers report that they always give consideration to the proposed standards but final choice of cycle is that which they consider most economical in the long run.

Some operators have used the proposed standards for years and find them satisfactory, others have found slight variations desirable, while still others consider it necessary for economic reasons to deviate completely from the standards as proposed.

Those who have worked on the standards expressed themselves as being opposed to forcing the use of rigid designs but favor modifications in the line of progress.

Wartime Operating Problems

Power plant operation under wartime conditions was discussed by a group of engineers interested in industrial power who were called together by F. M. Gibson. Ollison Craig, who led the discussion, stated that four basic problems are encountered in power-plant operation today: Getting most out of existing equipment; fuel problems, including conversion; maintenance; and securing and training new personnel.

During the discussion it was emphasized that due to the needs for war materials, the so-called non-essential factories and other industries are compelled to make present equipment serve their purpose since priorities for new equipment are almost impossible to secure and this condition is expected to remain for the duration. These problems are being met in many ways through the ingenuity of operating and consulting engineers. In one case reported, redesigning boiler breechings enabled a 50 per cent increase of load on a boiler. In another, changing baffles gave 15 per cent additional boiler capacity. A reduction of 100 deg. in stack gas temperature was effected by baffle changes.

In many plants fuel problems are of paramount importance. It has been found that in converting from oil to coal some boilers cannot maintain the load formerly carried. Waste fuel is being used more economically. Slagging of fuel beds has been experienced in some plants compelled to use lower grade coals and this has been solved by cooling the furnace with water walls and bridgewall tubes, changing baffle positions and enlarging furnace by moving bridgewalls.

During the war period, engineers recognize the importance of maintaining plant equipment in first class operating condition and in many instances have increased the number of men engaged in that work to the point where, in some cases, they operate what is virtually a rebuilding factory for valves, traps, pumps, fans, engines, motors, electric switches, and even turbines.

Prime Movers

Gas turbines, which have been in the process of development, have within recent years become commercially feasible in some fields, notably the oil refining industry, are beginning to make progress in the railway and power fields, as brought out in papers presented at this meeting.

In the field of steam turbines, authors pointed out the important part supervisory instruments are beginning to play in the operation of large units. These instruments not only assist the engineer in maintaining efficient operation but in prolonging the life of the equipment. Records taken of shaft eccentricity, bearing vibration, shell expansion, speed, and camshaft position are means of detecting incipient causes of failures, a function extremely important during times when outage must be reduced to a minimum.

The problems surrounding the practice of supercharging Diesel engines were discussed in three papers. In one, Ralph Miller analyzed the rating of supercharged engines and came to the conclusion that engines of this type should be rated in accordance with pressures and mean temperatures as determined by design and established practice.

Frederick A. Hiersch, in a second paper, developed an equation in which volumetric efficiency may be substituted to obtain an inlet-air-temperature correction in a Root's supercharger.

The third paper tied in with the supercharging problem, presented by P. H. Schweitzer, was prepared to show that the conventional definition of volumetric efficiency for internal combustion engines should be discarded and replaced by a more satisfactory definition. His analysis indicates that it is only with incompletely scavenged Diesel engines that the conventional definition fails.

As the result of a series of tests of centrifugal pumps, A. F. Stepanoff presented data upon which he has come to the conclusion that the optimum gross pump efficiency of centrifugal pumps varies with the specific speed of pumps, reaching its maximum at specific speeds of 2000 to 3000 for double-suction pumps.

Interest in the spreader types of stokers has been noteworthy during recent months, particularly among engineers who are compelled to convert from oil to solid fuel, not only because of demonstrated high efficiency but because of the wide variety of fuels this equipment will handle satisfactorily. These facts were brought out in a paper by R. L. Beers which dealt principally with descriptions of installations using western lignite, midwestern and eastern coals as fuel, citing installations that gave heat absorption efficiencies as high as 87.5 per cent.

Instrumentation

Activity in the field of industrial instruments, particularly those having to do with the control of process, has been increasing during recent years and it is noteworthy that the Committee on Industrial Instruments and Regulators has requested the Council of the Society for the privilege of forming a technical division of the Society whose activities would be devoted entirely to the problems of instruments and regulators.

At this meeting consideration was given by J. G. Ziegler and N. B. Nichols to process lags in automatic control circuits; by P. W. Keppler to the desirable characteristics of valves and final control elements for cascade control; by James L. Kimball to changing regulator characteristics to meet difficult control problems; by R. J. S. Pigott, E. E. Ambrosius and E. W. Jacobson to volumeters for liquid hydrocarbons; by W. J. King to measurement of high temperatures in high-velocity gas streams; and by W. S. Pardoe to the effect of installation on the coefficients of Venturi meters.

15th National Power Show Reflects WARTIME PROBLEMS

FACED with four vital wartime problems — fuel difficulties, manpower troubles, material shortages, demand for maximum continuous capacity — engineers from all over the country attended the 15th National Power Show at Madison Square Garden,, New York City, from November 30 to December 4, 1942. There they visited exhibits featuring methods for improving coal storage practice, combustion of fuels and boiler operation, methods for increasing capacity by preventing heat and material wastes, automatic control equipment to help spread the skill of available personnel, new materials and substitutes for unobtainable materials in maintenance work and a number of new tools and fabricating techniques for both production and maintenance.

Coal Storage and Combustion

Reflecting the current interest in coal storage problems (see POWER PLANT ENGINEERING, July, 1942 issue) one exhibitor presented a hot spot indicator for coal storage piles.

The indicator consists of a pipe driven into the pile and containing a spring-loaded, mechanical signal released by the melting at 150 deg. F. of fusible links at 1-ft. intervals inside the pipe, hence the location and depth of a danger spot are known well before combustion begins. At this hot spot, the exhibitor recommended driving a pointed, perforated piece of 3-in. pipe containing dry ice (solid CO_2). The CO_2 gas, released through the pipe perforations, blankets the danger zone, preventing spontaneous combustion or putting out a fire if it has started.

An automatic combustion control system was on display, featuring electronic relays controlling fuel, combustion air and furnace draft regulators in full operation on a model boiler, all coordinated by an "electric eye" measurement of smoke density to maintain best combustion. The system is designed to provide adjustable electrical throttling and reset compensation to preclude hunting.

Combustible gas analyzer of a new type for measuring $CO + H_2$ was on display, adaptable for boiler flue gas and industrial measurements. In this analyzer the difference between the volumes of a gas sample before and after burning is measured by an electrical bridge circuit actuating a recorder calibrated in terms of CO_2 or other desired quantity.

Sectionally-supported furnace walls and arches were advocated by one exhibitor as an aid in quick conversion of furnaces from oil to coal burning and also as a method of cutting furnace maintenance.

For application both in conversion of firing and in promoting fuel economy, one manufacturer showed working and cut-away models of pneumatic spreader type and underfeed stokers for boilers up to 1000 hp.

For minimizing furnace refractory troubles, one manufacturer showed a refractory coating, a combination of high fusion clays and metals combined in oils, to be brushed or sprayed on refractory walls. The furnace heat vitrifies the coating, which is designed to seal the refractory pores and prevent the refractories from cracking, spalling and disintegrating under wide temperature variations and the chemical action of hot furnace gases.

A number of exhibits featured methods for saving heat in steam after generation, thus increasing effective boiler capacity.

A well-known line of steam traps was displayed by large operating models, including the latest models of an inverted bucket trap for 10-250-lb. pressure and capacities up to 9800 lb. per hr. and an expansion trap especially for outside pipe lines and extensive systems where condensate cannot be returned to the boiler. For eliminating water from compressed air lines, another exhibitor featured a bucket type air trap.

Conservation of heat by means of proper insulation, both in generation and distribution, to increase effective capacity by saving fuel and decreasing transmission losses, was emphasized. Prefabricated, pre-sealed insulated pipe sections in one booth showed details of covering, insulation, joints and expansion provisions.

Methods of testing the properties of one of a line of insulating materials were shown at another exhibit by a test cell with which the thermal gradient through the insulation was measured. This cell can also be used for furnace wall tests.

Water Treatment Problems

Interest in correct feedwater treatment practices to promote maximum boiler efficiency was reflected by several exhibits. In one new chemical proportioner, a standard water flow measuring device operates the proportioner electrically, causing it to lower a swing pipe or skimmer into the chemical feeder in such a way as to pro-

portion the chemical feed to the water flow. Another exhibit showed a plunger-type, step-valve pump especially applicable to external or internal type feedwater treatment systems. This pump has double-ball inlet and discharge valves designed to be self-cleaning and thus prevent clogging by solids.

A third exhibit of proportioning equipment showed chemical proportioners with fluid seal on both plungers and stuffing glands to reduce maintenance and presented data on complete boiler feedwater treating systems including metering and control, cyclic timing and automatic back flushing.

Packing is so fundamental in the operation of all power equipment that much interest was aroused by the display of a new lattice-braid packing, internally as well as externally braided so that all wear is on end surfaces and the packing does not disintegrate, has great flexibility and controlled porosity.

Lubrication of machinery was featured by a number of lubricating oil companies as a vital factor in preventing shut-downs and attaining maximum efficiency.

Importance of control of steam for most effective use was typified by a display of a new pressure reducing regulator for steam, hot liquids and gases at initial pressures up to 2500 psi and temperatures up to 1000 deg. F. This unit controls the valve opening by means of an air loading pressure impressed on a diaphragm, without use of springs or pilot valve.

Substitutes for Hard-To-Get Materials

Uses of substitute materials such as wood and plastics in equipment design and maintenance—in short, keeping everything going when materials are hard to get—was of much interest to all engineers at the Show.

One of the manufacturers of brass and copper products, with an attractive display of raw materials and some fabricated war materials, is furnishing power plant men with data on getting the most out of the copper and brass equipment they now have. A manufacturer of steel control panels exhibited typical examples of his panels but was prepared to furnish data on how substitute materials could be used for this purpose.

An unusual use of substitutes was in a 10-ft. diameter, 8-blade propeller type cooling tower fan with blades of Hartzite, a plastic and fabric compound, replacing aluminum blades, and mounted on an all-steel hub with adjustable pitch devices. Another instance of metal replacement was an all-wood telephone booth, for power and industrial plants, constructed of plywood with an absorbent inter-layer. A most interesting example of substitution was a complete line of pulleys for both flat and V-belts, built entirely of wood except for the through bolts.

Machine Tools and Welding

Machine tools and fabricating methods for maintenance work included a new low-temperature welding process in which, by means of a special rod and flux and standard torch or electrical equipment, welding of steel, bronze, iron, aluminum and the like is done at temperatures ranging between 900 and 1400 deg. F. Repairs on castings, gears, water jackets, pipe, tools and other machine parts were demonstrated.

Many machine tools were shown in operation. These were of interest to engineers engaged in production work and some might be employed in power plant maintenance. A number of portable, flexible-shaft machines for drilling, grinding and the like were of interest, also foot-operated and pneumatic vises. A number of exhibits included roller bearings, variable speed drives, flexible couplings, speed reducers and other power transmission devices. Several displays of belting and gearing attracted attention and a variety of materials-handling equipment was shown.

The D. W. Haering & Co., Inc., research staff has recently announced the successful application of chrom glucosates for vapor phase injection in conjunction with ammonia for complete inhibition of corrosion in refinery equipment.

The company's field and research engineers have developed a method of controlling corrosion in salt water and brines making possible the use of iron and steel pipes to replace admiralty and high alloy tubing in the petroleum and allied industries.

Research is also being directed to the control of wire cable corrosion and additional experimental work is being carried out on cooling waters and condensate corrosion control.

A MOTOR IS SMOKING

(Continued from page 67)

A motor bearing properly bored will fit the shaft snug enough to run warm for a little while. Where a bearing can be felt to move sideways when tried on the shaft it is bored too large. In a small motor this will often take up a greater part of the clearance between stator and rotor, necessitating another change in a short time.

In the case of an overheated or burned out bearing the smoke and odor emitted will usually issue from inside the end bell misleading the casual observer as to its source. In the first instance under this heading a bearing had been allowed to go entirely dry of oil, due to the neglect of the maintenance electrician. In the other instance the contributing cause was a heavy drive chain improperly adjusted.

Two of the alarms as shown, originated from a slipping drive belt on the motor pulley. In each case the workman failed to recognize the true source of the smoke, but assumed that it was the motor itself, and so reported to the electrical department.

Of the two cases of genuine 'burn out' one was definitely due to the coils being soaked in lubricating oil.

To eliminate oil soaked windings all motor oiling must be carefully executed by the one in charge. This means that each bearing should be carefully observed to determine at what level the oil will remain in the oil gage without leaking out.

The average oiler will pour in oil until it overflows in the gage. This is all wrong. As long as the oil rings pick up the oil, the bearing is full enough for satisfactory operation.

These records indicate the necessity for more frequent and systematic examinations and adjustment of relays, fuses, and protective devices, as well as the contacts of starting switches.

For the motors themselves, regular and systematic examination of bearings and coils, and the frequent gaging of the air gap is necessary. In actual practice such cases as are here enumerated have been practically eliminated by these precautions.

Put Your DORMANT SCRAP Into the War

YOUR HEAVY SCRAP is needed NOW to help win this war. It has been found that the millions of tons of production scrap now being salvaged by American industry and of household scrap turned in by the American people can be used much more effectively and quickly if mixed with large quantities of heavy scrap. Therefore the Industrial Salvage Section of the WPB urges you to get your dormant scrap into the war production stream—NOW!

Every fighting man in World War II needs 4900 lb. of metal—mostly steel—in the form of fighting equipment. This is 50 times what he used in World War I, which was only 94 lb. Approximately 50 per cent of all steel, even in normal times, is composed of scrap. Because this scrap has previously been refined, it can be mixed with pig iron to make steel much faster than if pig iron alone is used. Furthermore, the steel now goes overseas as weapons and much of it does not come back. Half of every tank, gun, submarine is iron and steel scrap.

What Is Dormant Scrap?

Dormant scrap consists of obsolete machinery, tools, equipment, dies and the like which are incapable of current or immediate future use in the war production effort because they are broken, worn out, irrepairable, dismantled or in need of unavailable parts necessary to practical reemployment.

The Industrial Salvage Section of WPB recommends that you follow this rule: **If it hasn't been used for 3 mo., and if somebody can't prove that it's going to be used in the next three—sell it or scrap it!**

Scrap and the Maintenance Problem

Yes, everybody knows you have a serious maintenance problem. If you scrap too much stuff now, you may be caught short later on in an emergency. But you can try to strike a balance between holding a reasonable amount of repair and maintenance material and saving material just because you "may need it some day."

For a lack of scrap could conceivably lose us this fight. And then what good would you get from the stuff you had saved?

What to Do?

First, in every company a salvage committee should be formed and a salvage manager put in charge. A high executive should be selected for this job, one who has the authority to make decisions, to overrule the string savers and to take the responsibility when someody asks next year: "Who in blazes threw that old pump away?"

Second, this executive and the salvage committee should go over the plant with a fine-tooth comb, marking what is to go into scrap.

Third, see that it goes!

Make a Check List

The best thing to do is to make a check list for your plant somewhat along the line shown in Fig. 3. List not only complete units but also parts, such as tubes, bolts and nuts, shafts, bearings, pistons, blades, and the like. Then look at each item objectively, scrap it if possible.

If you find material that is still usable by somebody else, your scrap dealer or used machinery dealer will buy it at higher than scrap prices.

Scrap is deductible from income tax. This is important. See your accounting department about deducting scrap value from income tax.

Sorting and Selling Scrap

Do you have to sell your scrap to a scrap dealer? Yes, you do, because nobody else is set up to sort and process scrap. There are 75 recognized grades of steel alone. Sort it according to material and separate usable items from the mass. You will get higher bids and if the tonnage is high you might get competitive bids from more than one dealer. The scrap dealer, of course, makes a profit. But his job is an important one and his prices are regulated by Government ceilings.

What types of dormant scrap are you likely to find? The first thing that will occur to you, of course, is unusable machinery such as motors, blowers and fans, compressors, pumps, piping, valves and the like that somebody else can use. Look for such items as unused railroad track, old monorails and conveyor equipment, line shafting and hangers that have been replaced by individual motor drive and similar items. You may find pre-war replacement parts with nowhere to go until after the war. It might pay to scrap them and write off the cost, hoping to get something back in tax reduction.

Even if you have already made a search for dormant scrap and turned in some of it, try again. It has been proved time and again that, no matter how well you did before, you can always turn up more scrap.

Item	In Use	For Resale	Standby	Scrap
Turbines				
Generators				
Condensers				
Boilers				
Pumps				
Compressors				
Switches				
Wiring				
Controls				
Electric Motors				
Drive Shafting				
Pulleys Hangers				

Fig. 3. Suggested form for a check list of power equipment. Make your own to suit your conditions. This is for complete units. You'll want to break down each item into a parts list, because you're probably operating all your complete units right now. Under steam engines you might list:

Frames, bed plates, cylinders
Crankshafts, connecting rods
Pistons and piston rods
Bearings and bearing materials
Valves, governor parts
Fly wheels
Bolts, nuts, misc. fittings

Fig. 1. (Left) This planer, used only 3 or 4 times a year, was not scrapped but sold to a war plant. The buyer operates it 20 hr. a day

Fig. 2. (Right) Oh, boy! Look at the dormant scrap—potential machine gun and tank parts! But they are on their way to the Axis now

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

MEET MR. EARLE

To those who have been reading Power Plant Engineering for over 10 yr., Chester R. Earle, our new associate editor, needs no introduction. He was an important member of our editorial staff from 1924 to 1932. He returns to the staff now directly after several years with the Republic Flow Meters Co. where he has been in direct contact with power plant engineering problems in many industries.

Mr. Earle was graduated from Tufts Engineering School with a B.S. degree in Mechanical Engineering. In the first World War he served as Ensign in the U.S.N.R.F. Following the war and prior to his association with Power Plant Engineering in 1924 he was employed in the engineering departments of Arlington Mills, Lawrence, Mass., and Haverhill Boxboard Co.; as instructor at Dummer Academy; and as assistant professor, Michigan College of Mines.

The return of Mr. Earle to our staff is not only gratifying to us but his experience and knowledge of the power field will be reflected in the quality of the editorial content of Power Plant Engineering. Contributors of this section can look forward to many pleasant contacts with him.

Particular attention is directed to the "hay burner," overall efficiency minus 12.6982 per cent. That's part of the regular equipment. Wherever Chester goes, there also goes the pipe. He smokes an herb familiarly known to his former Republic associates as "mule bedding"—actually Edgeworth sliced plug. This is not a plug for the tobacco, however.

A. W. K.

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago, Ill.

Pass the Ammunition

Why are so many power plant operators downtrodden wretches? Why are they so afraid to go to their chiefs for information on questions relating to their work? Why are these chiefs reluctant to answer their questions? As one of our correspondents puts it, "knowledge is power but why hide it?"

By ANDREW W. KRAMER

THE DRAFTEE in the army gets a base pay of $50 per mo. When he is inducted into military service he gives up nearly all of his privileges as an individual. His time is no longer his own, he must do whatever work is assigned to him whether he likes it or not. He loses all rights and privileges to personal initiative and private enterprise. Even though he advances in rank and spends the rest of his life in the service, he can never hope to get rich. If ordered to give his life in battle he has no alternative but to do so. He is in the army.

A typical war worker working on a construction job—an electrician or a plumber or a steamfitter—today gets anywhere from 50 and 60 to 100 and 150 dollars per *week*. He retains his rights as a citizen, is free to do what he pleases and if he does not like his work he is still free to quit and look for a new job. His work involves only the ordinary hazards of civil life and industry. From a financial standpoint, the war worker's work is apparently of much greater intrinsic importance than that of the soldier.

An average operator in a power plant not in the chief engineer class receives anywhere between 25 and 30 dollars to 40 and 50 dollars per week, but very few get the latter and many chief engineers in small plants do not get much more than that. This is better than the army, but in most instances these men have considerable responsibility, much more than the average steamfitter doing routine construction work; yet financially they receive much less.

He's in the Army now

Is there something wrong with this whole set-up? Why are power plant operators so poorly paid in comparison to the building trades worker or even the skilled worker in the industrial plant? Is it because they are poorly organized as compared to other tradesmen or is it because there are no clearly defined divisions between the duties of various types and classes of power plant personnel?

Whatever the reason, it is very evident from letters we receive from operators that there is a great deal of room for improvement in the financial status of the power plant operator.

One trouble, perhaps, is in the isolated character of their work. They work in a world known only to themselves. Their contacts with the front office are few and since they are not engaged in "production" their efforts, though important, are regarded in many instances in the light of a necessary evil. While their efforts can be translated into terms of dollars and cents, it is not always easy to express these operations in terms that the management can understand or appreciate.

There seems to be a certain reticence among operators to exchange information or to give younger men the benefit of their experience. In a letter from one of these younger operators, a man 29 yr. old and a frequent contributor to these pages, he writes, "What irks me is the indifference many men in power plants have to each other. . . . I can truthfully say that in all the plants I have worked, the engineers seem to be afraid of each other. Knowledge is power but why hide it? Whenever I bring up a problem I am side-tracked and given an evasive answer. The only way I can figure it out is that they do not know the answers themselves. Hang it all anyway."

This man is a good conscientious engineer, one who buys and reads technical books and magazines relating to the work he is interested in and who is making a sincere and conscientious effort to advance in his profession. He has had considerable practical experience and occupies a position as engineer of a boiler room in an industrial plant. His present salary, just short of $2800 per yr. is the highest he has ever received.

No doubt, many exceptions can be found to the lack of cooperation between engineers pointed to by this writer, but there is a considerable amount of truth in what he says. Engineers are not as prone to passing on information to younger men as they could be. Whether this is intentional or whether it is a result of their temperament does not matter, the important point is, it is detrimental to the profession as a whole. Knowledge is the ammunition which the engineer needs to carry on his eternal fight against inefficiency and outage.

Running a plant these days is not what it used to be. It demands not only experience with equipment but a basic knowledge of physics, chemistry and fundamental mechanics. There is plenty of room in the field for new blood, for young men who would like to make power plant engineering their profession and every encouragement should be offered such men.

The letters we receive almost daily from power plant operators in all types and sizes of plants and in plants from all parts of the country indicate not only a deplorable lack of knowledge but a woeful lack of guidance as well. Some of these letters are quite pathetic, but all of them reflect a high degree of sincerity. These are not the letters or questions which we publish in these pages, indeed, often the letters are appended with a postscript asking us not to publish the letter or the names of the writers since they feel that their jobs would be jeopardized by so doing.

It should not be necessary for operators to write to us for simple data and information which their chiefs should be able to tell them offhand. If their chiefs are reluctant to pass on such information something is very rotten not only in Denmark but in the power profession; if they do not know the answers themselves, as our correspondent suggests, something is equally rotten.

In large central station organizations, there are usually opportunities for operators in the power stations to attend classes where they receive instruction along technical as well as practical lines. Such opportunities are not usually open to an operator of a small industrial plant. If his plant happens to be in or near a large city, true, he may be able to avail himself of courses given in technical schools and colleges provided his working hours are such that he can attend the classes, but even then quite often he is working alone and more or less in the dark. What he needs is more guidance in his educational efforts and no one is in a better position to furnish this guidance than his superiors in the power plant, provided they are capable men.

There probably is no prospect of doing very much about these matters unless some concerted effort is made by the operators themselves. There are many capable, high minded chief engineers in the field who do stimulate the personnel under them towards self improvement. If in some way they could extend their endeavors in this direction at least throughout the confines of their own communities, they would make a worthwhile contribution to the field as a whole.

Locate Static Condensers at Strategic Points

The advantages of the use of static condensers in improving power factor are generally known, but a point that is often overlooked is the need of locating the condensers at the most strategic point to provide maximum benefit. The analysis of conditions in an electric furnace installation show that proper attention to this factor will result in subsantial savings

By L. M. DURYEE

Industrial Power Engineer, The Connecticut Light & Power Co., Waterbury, Conn.

JUST A YEAR ago the Seymour Mfg. Co., Seymour, Conn., due to increased war production, faced the necessity of adding four more 100-kw. induction melting furnaces in their casting shop. The induction melting load already in use consisted of ten 100-kw. induction furnaces. The total plant load was 2200 kw. at 68 per cent p.f., or a total of 3240 kv-a. The power transformer bank in the plant substation was 3000 kv-a. in capacity. Thus, the addition of 400 kw. more of melting load at 65 per cent p.f., would have resulted in a transformer kv-a. load of 3240 plus 400 ÷ .65, or a total of 3855 kv-a. of load. This excessive addition would have overloaded the bank of transformers by 855 kv-a., or 28 per cent, which in hot weather, and with the continuous 24 hr. load necessitated by defense production, would have resulted in excessive voltage drop, and probably in transformer failure. Either a new substation was indicated, or else a substantial reduction in wattless current was necessary.

The power company's subsequent recommendation for the customer to install 1200 kv-a. of capacitors was therefore put into effect. The condensers were purchased by the customer in the form of 10– 120 kv-a. units, at 440 v. (the plant operating voltage.) The result was a plant load of 2600 kw. at a measured average 90 per cent p.f., or 2800 kv-a. average transformer load. (Since average power factor of the plant over the 24-hr. period was used for billing, the condensers had slightly more corrective effect at night time when loads were not so heavy, thus increasing average measured power factor above the value at short intervals of full load.)

The return on the condenser investment was in the form of a reduced power bill (demand charge) of 7 per cent × 2600 kw. × $1.25 per kw. × 12 mo., or $2700, on this single item. In addition to this reduction, there was also a decrease in conductor I^2R heat loss. This was calculated as follows: 2¼ in. by 4 in. buses per phase, 190 ft. long feeding the casting shop. Current of this load, which was 1750 kw. including motors (at 61 per cent p.f.):

$$\text{I at 61\% p.f.} = \frac{1{,}750{,}000}{440 \text{ v.} \times 1.73 \times .61} = 3800 \text{ amp.}$$

$$\text{I at 90\% p.f.} = \frac{1{,}750{,}000}{460 \text{ v.} \times 1.73 \times .9} = 2400 \text{ amp.}$$

(Voltage improvement was obtained by increasing transformer taps as well as reduction in IR drop)

Resistance of 2¼-in. by 4-in. copper buses 190 ft. long:

$$R = \frac{11 \times 190 \text{ ft.} \times 3}{2{,}500{,}000 \text{ c. m.}} = .0025 \text{ ohms}$$

Losses: $I^2_1R = (3800)^2 \times .0025$
$= 36{,}000$ watts (uncorrected)

$I^2_2R = (2400)^2 \times .0025$
$= 14{,}000$ watts (corrected)

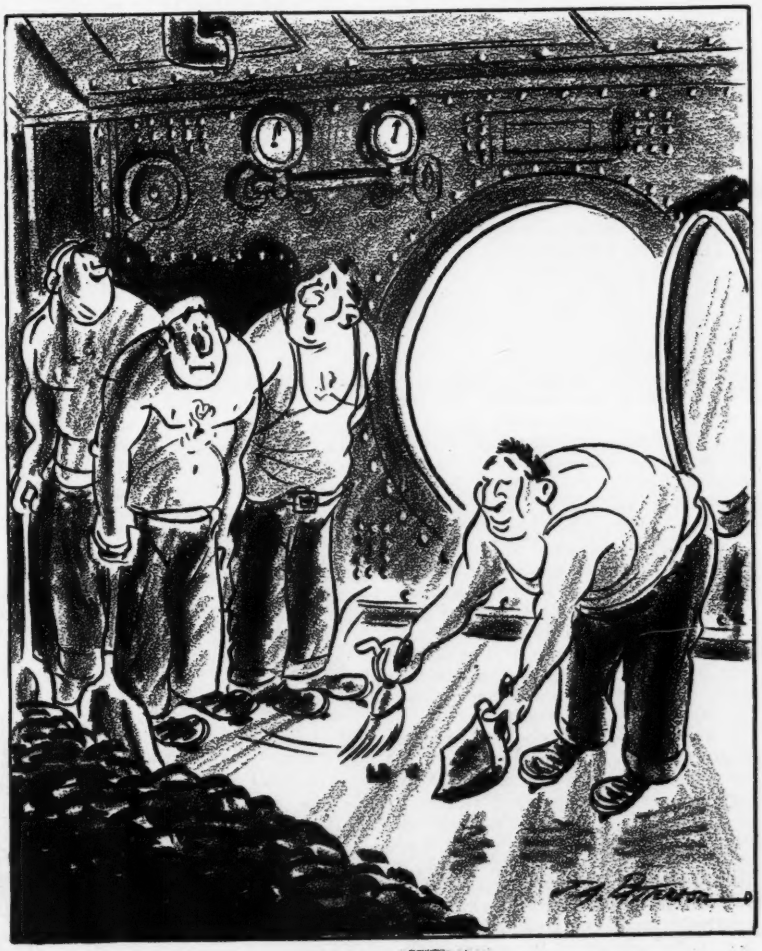
Saving in conductor heat losses
$= 22{,}000$ watts

Energy reduction $= 22$ kw. $\times$ 24 hr./day $\times$ 320 days $\times$ 8 mills/kw-hr.
$= \$1350$ per yr.

Total savings—

Reduction in Demand Charge	$2700
Reduction in conductor heat losses	1350
Total	$4050 per yr.

Thus, the actual investment of $8500 for condensers was returned on the basis of 47.5 per cent per yr., disregarding the fact that no money was spent in enlarging the transformer substation, which would have been necessary if condensers had not been purchased. The net



"Neat, isn't he?"

condenser investment was therefore substantially less than $8500.

The location selected for connecting condensers was in the casting shop itself, on the line side of the oil switches of 10 of the 14 furnaces, right at the panelboards. The advantage of this location lies in a high degree of safety, for, being ahead of furnace oil switches, the condensers are never disconnected. Thus, when furnaces are dismounted for relining, the workmen are never subjected to the condenser discharge voltage.

Due to the improvement in voltage in the casting shop, the question was recently raised as to why the condensers could not be relocated even closer to the furnace terminals themselves. If, in other words, the condensers had improved casting speed so noticeably in their present location, would they not speed up casting still further by being located at the very source of wattless current? The following study was made, to arrive at a conclusion.

Heat losses in 50 ft. of 2-wire 300,000 c.m. conductor from panelboard to each furnace:

Resistance of 300,000 c.m. 50 ft. long
$= .037 \times .005 = .00185$ ohms

Current of one furnace at 61 per cent p.f.
$$= \frac{100{,}000}{460 \times .61} = 356 \text{ amp.}$$

Current of one furnace at 100 per cent p.f. if condensers were separated in size and connected to furnace terminals:
$$= \frac{100{,}000}{460 \times 1.0} = 217 \text{ amp.}$$

I^2R losses at 61 per cent p.f.
$= (356)^2 \times .00185 = 234$

I^2R losses at 100 per cent p.f.
$= (217)^2 \times .00185 = 85$

Difference 149 watts per furnace

Ten furnaces would save only 1490 watts—negligible amount.

IR drop at 61 per cent p.f.
$= 356 \times .00185 = .66$

IR drop at 100 per cent p.f.
$= 217 \times .00185 = .40$

Reduction in IR drop $= .26$ v. (negligible)

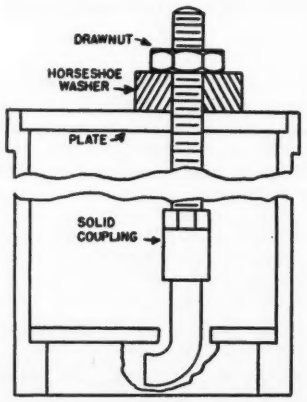
Therefore it was concluded that the condensers, at furnace panelboards, were performing to best advantage. A further reason for this conclusion lay in the fact that condensers were supplying the correct amount of leading kvar. and any reduction in the ratio of kvar. to kw., by disconnecting condensers with furnaces, would have reduced the annual reduction in the power bill, and therefore also the return on the investment.

Complete satisfaction has been experienced in the year's operation with the new condenser installation. There is still some leeway in the transformer capacity for some necessary added load, eliminating, again, the necessity for enlarging the substation. Copper conductors have been running cool, and copper capacity has been released for productive work instead of being loaded with wattless current. Also, of course, the power company supplying this load has been able to reclaim 1000 kv-a. of generator, transmission and distribution equipment, which is a relatively small but tangible contribution to the solution of the power problem in today's war program.

Removing Balky Pump Valves

By P. C. ZIEMKE

STUCK VALVES can present quite a problem, especially when time is at a premium and shut down costs are piling up. The device illustrated is easily constructed from a ⅝ in. bolt (or any size to suit the job) and several suitable nuts and washers. The tapped sleeve at the bottom of the assembly is used to facilitate placing the hook into the valve body.



Balky pump valves can easily be removed with this tool

The straight portion of the bolt is then screwed in, the upper plate is dropped, the horse shoe shaped washer slipped on and the hexagon draw nut threaded on ready to begin pulling. Usually a few turns of the wrench brings the obstinate valve up free from the seat.

Try the Junk Box First

TODAY one of the first steps that can be taken by the operator, to help himself, is to make a study of what is going into the junk box. These may become potential stockrooms, and if he has not already done so, he should start to establish a psychology of thrift. Larger companies, appreciating the savings in a salvage program, have been doing this for years. Today this must be intensified by a closer scrutiny of every worn or broken part to determine what can be done to save it.

One should appreciate what welding can accomplish. Old parts can be welded and returned to stock or to service to minimize waiting time. To assure that original specifications had been welded back into the part, the work should be done by a man who knows his business. In momentarily accepting a lower standard of living it becomes necessary to prolong the life of all of our material things, we must exert our ingenuity to make repairs skillfully to assure a reasonable degree of permanence.

Refrigeration Float-Control Trouble Eliminated

By CHISMAN A. LEE

WE HAVE a float-controlled valve on the high side of a flooded-coil system. This valve was considered good in 1930 but always gave some trouble at 15 lb. and 20 lb. suction pressures. It had a long piston-needle with a conical end and would get sluggish and stick even though lubricated strictly according to directions with standard ice machine oil.

Although the plant was rated at 35 t. it was loaded up to the point where we had no safety margin. We tried raising the condenser pressure and used a thermometer to check the superheat in the suction line. However when the valve stuck we would have frost on the ice machine. It looked for awhile as though we would have to install an up-to-date float valve but, a very simple change eliminated the trouble.

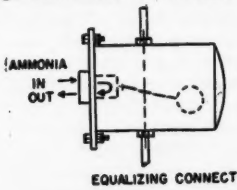


Fig. 1. General arrangement of the float valve that caused trouble

As ammonia passes through orifice it reaches almost the same pressure as that in float chamber. It looked as if we could cut away two-thirds of the frictional area and help ourselves along. We removed needle and cut it down until it had contact at two ends only and now it gives no trouble. There must be a number of valves of this type which could be changed to advantage in the same way.

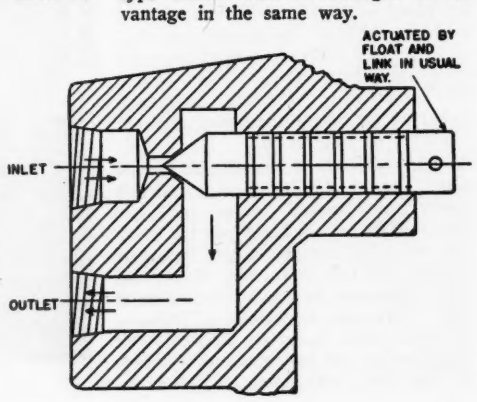


Fig. 2. Detail of the valve stem that caused trouble by sticking. The trouble was corrected by turning the stem down (as shown by the dotted line) to the bottom of the original oil grooves (shown solid)

Variable Speed Drives Extend Use of Machines

By FRANCIS A. WESTBROOK

IN THE CONDUCT of the war production program it is essential that all parts of the manufacturing system be equally effective. Where mechanical transmission equipment is involved, such equipment should receive the same care in its selection and maintenance as the machines they link to the driving motors or other prime movers.

Often the speed of a machine has a direct bearing on its productive capacity and in such case the selection of proper variable speed coupling is as important as the selection of the machine itself.

Where the speed of a driven machine has to vary over a considerable range, two courses are open to the designer of the installation. First, he can select a constant speed motor and interpose a variable speed coupling between the motor and the driven machine, or second, he can select a variable speed motor for the installation.

Which of these two solutions he decides upon in any particular case depends upon several conditions which deserve careful analysis.

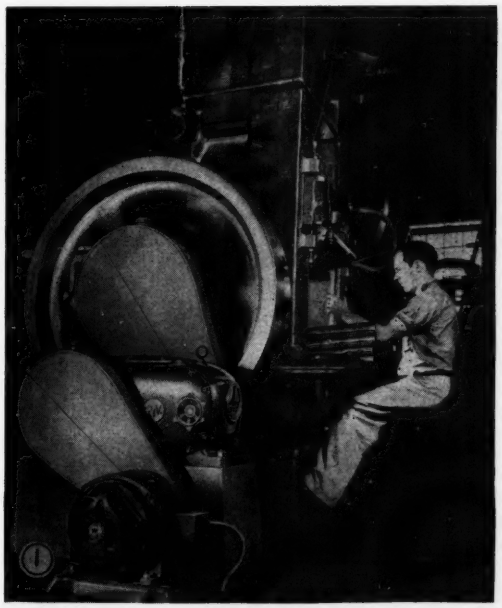
In general, constant speed motors are lower in first cost than variable speed motors and they are more efficient. The selection of such a motor for a variable speed drive, however, necessitates the use of a variable speed coupling and this has to be added to the cost of the motor.

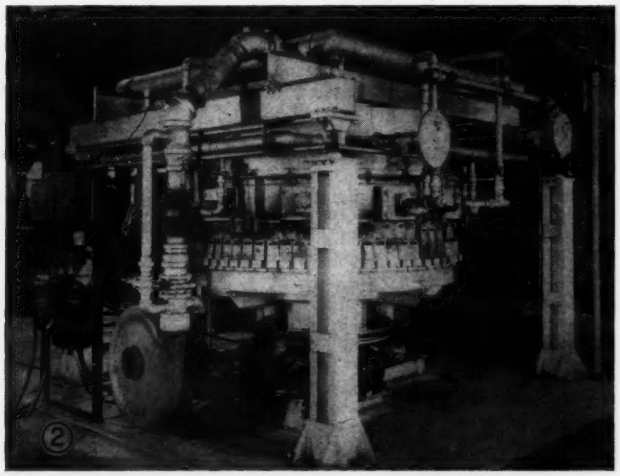
There are many instances, however, where the use of such variable speed coupling devices have advantages over the use of a variable speed motor. This is especially true where machines that have normally had constant speed drives are being adapted to new uses requiring different speeds.

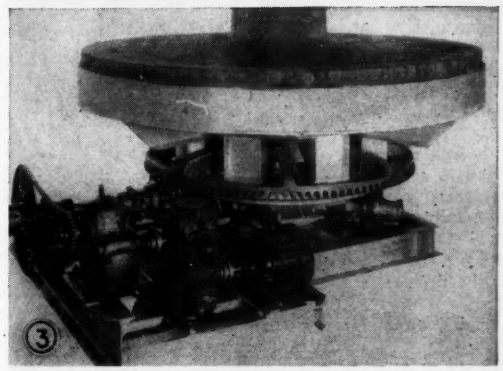
In such cases, the addition of a variable speed coupling gives new flexibility to an existing machine. Under war conditions many existing machines are being adapted to new purposes and the addition of variable speed couplings may mean the entire difference between production and non-production.

In order to show how such variable speed drive units are applied to advantage a few actual examples have been selected and presented here. As shown by the photographs, they are indicative of present day practice in this field and they may suggest other uses.

In Fig. 1 is shown a machine in a western Pennsylvania plant making collapsible tubes. The tubes are made with this 130-ton extrusion press in







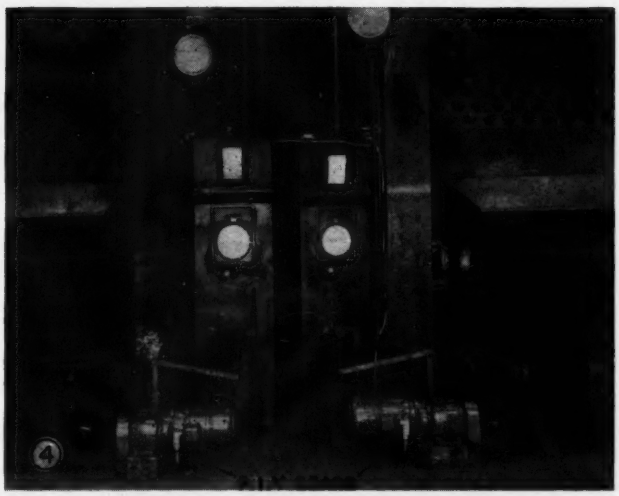


Fig. 1. Extrusion press equipped with variable speed control unit to provide for efficient production of different size collapsible tubes. Fig. 2. Underfeed stoker equipped with variable speed control unit which increased boiler efficiency 8 per cent. Fig. 3. Slot type rotary forge furnace with mechanical variable speed control. Fig. 4. Details of speed control mechanism of the furnace shown in Fig. 3

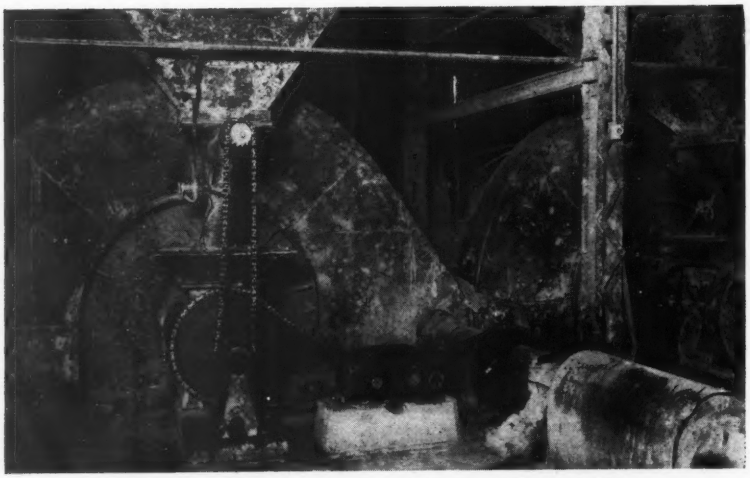


Fig. 5. Tube mill drive in a cement mill with variable speed drive

sizes up to 2½ in. in diameter by 14 in. long. They are made of lead or block tin extruded from a blank, their length depending on the thickness of the blank.

As originally installed this press was satisfactory for extruding the larger sizes of tubes but not for the smaller sizes, and for this reason a gear variable speed transmission was inserted in the drive. This has a 3 to 1 ratio and gives a production speed range of from 12 to 36 tubes per minute with a 5-hp., 1650 r.p.m. punch press motor. This provides the best speeds for automatically feeding the small tubes to the press and air stripping them from the die, and hand feeding and stripping the larger sizes.

During several years of almost constant operation, during which the press has been inadvertently stalled more than once, there has not been any trouble with any part of the drive, and maintenance costs have been negligible.

The efficiency of the boiler plant of a large cotton mill in Virginia was increased some 8 per cent by installing a variable speed unit in the underfeed stoker drive and providing automatic combustion control. This unit, shown in Fig. 2, was applied to two 45,000-lb. and four 35,000-lb. per hr. boilers. The steam flow-air flow principle of the Bailey boiler meter is used for controlling the speed of the stoker, without reference to the load or condition of the fuel bed, by means of a piston type control drive actuated by the steam flow-air flow control of the boiler meter. The latter positions the lever on the variable speed control whereby the speed of the stoker drive is changed automatically in accordance with operating demands and thereby maintains the most efficient combustion conditions. This concern uses some 80,000 tons of coal per year, or more, and a saving of 8 per cent runs into real money.

A very interesting application which shows how much can be accomplished by positive speed control is a slot-type rotary forge furnace built by the Surface Combustion Co., of Toledo, Ohio, for a large mid-western forge shop, Fig. 3. It gives flexibility in the use of the furnace.

The speed at which the furnace should be rotated depends on the size of the pieces to be heated and, as these vary to a large extent, the variable speed control has been installed in the drive to provide for rotating speeds of from 10 to 60 min. per revolution. The hearth speeds may also be adjusted by the same means when the furnace is used for hardening operations, as is done at certain times.

The drive consists of a 1-hp. motor, the variable speed transmission with a ratio of 6 to 1, a double-reduction worm gear speed reducer with a fixed speed ratio of 900 to 1, roller chain drive, encased flexible couplings, rigid pillow blocks and bevel gear and pinion.

At a cement mill in eastern Pennsylvania there are several tube mills with feeders having variable speed transmissions in the drives (Fig. 4). The mill is powered with an individual synchronous motor and is driven by a spur pinion drive. The drive for the feeder is taken off the same shaft on which is mounted a split wheel sprocket for an increaser roller chain drive to the constant speed shaft of the variable speed unit.

From the variable speed shaft of the latter there is a decreaser roller chain to the feeder drive shaft. By means of this speed control the feeder may be run at any speed between 1720 and 430 r.p.m., a range of 4 to 1, with 4.5 hp. at the higher speed and 2.3 hp. at the lower speed.

The grinding done in this mill reduces the material to 200 mesh, and accurate speed control is essential to producing this result with maximum efficiency.

A further interesting feature of this tube mill installation is that the drives in their present form represent a modernization of the previous drives, and are a great improvement.

By having the variable speed units it was possible to remove two countershafts with cone pulleys and flat belts. The latter slipped a great deal so that the maintenance was too high and the performance of the feeders irregular, nor was the speed adjustment sufficiently quick, safe and positive.

The automatically lubricated chain drives of course did away with the slippage and the variable speed unit provided the requisite control with great accuracy, not to mention the resulting savings in maintenance and other advantages of improved performance.

NOTE: The photographs used in this article were kindly furnished to the author by Link-Belt Co., Chicago, Ill.

Apostrophe to a Boiler Pump

By JOHN O'CONNOR

You vex me, pump,
Vex me!
Y' grump you vex me!
VEX ME!
VEX ME!
You slither,
Swoosh and swirl and swish
"Squoo-oo-oo-oosh—
Sqush—Squoo-oosh—
Squish—"
You plunge,
You lunge,
Like slipp'ry fish
Blundering 'round
Perplexedly!

You run tip-top,
And idly—
Stop.
You flutter,
Dance with staid ease;
Again—
Lie dead.
You slyly jump
And ram the head
A sounding thump
"S—Sock!"
A shock!
As meteors bump
A' hurtling on to
Hades!

I check your yoke,
Tinker and poke,
I jog the tappet—
Vainly;
Dig out your guts,
Your packing rings,
Your valves,
The nuts and studs and springs,
And—My,
Oh my,
My utterings!

Now go,
You!—You!—You!—
Zany.

* * *

Linear couplers are now available for relays and circuit breaker trip coils to the primary a.c. mains. These couplers are designed with no iron in their magnetic circuit so that their response to fault currents is practically instantaneous. With these couplers relay operation is obtained for practically all faults, under ¾ cycle.

The Why, When, Where, What and How of

FLOW METER INSTALLATION

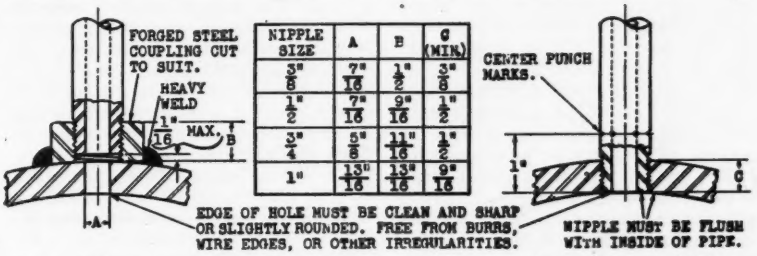
Part IV. Installing the Orifice or Flow Nozzle, centering, direction of flow, gaskets, flanges, pressure taps, reservoirs and detailed directions for obtaining the maximum accuracy

By W. C. BENNETT
Cochrane Corp.

AFTER the location of the orifice or flow nozzle has been determined, in accordance with the considerations covered in Part III[1], it is imperative that the installation of the metering element and pressure connections be made with extreme care. Recommended methods of doing this for steam, liquids, air and gas, for vertical, horizontal or inclined flow and for flange taps or pipe taps are shown by Fig. 1[2].

Before installing the orifice or nozzle, however, the internal diameter of the pipe should be checked by means of four diagonal measurements taken at the locations of both the upstream and the downstream taps. Check the average of these measurements against the design dimension of the primary element and refer any discrepancy immediately to the meter manufacturer for appropriate action.

Then the orifice or nozzle must be very carefully installed in the line, especially as regards:


FORGED STEEL COUPLING CUT TO SUIT.
HEAVY WELD
1" / 16 MAX.
B
A
EDGE OF HOLE MUST BE CLEAN AND SHARP OR SLIGHTLY ROUNDED. FREE FROM BURRS, WIRE EDGES, OR OTHER IRREGULARITIES.
CENTER PUNCH MARKS.
1"
C
NIPPLE MUST BE FLUSH WITH INSIDE OF PIPE.

NIPPLE SIZE	A	B	C (MIN.)
3/8"	7/16"	1/2"	3/8"
1/2"	7/16"	9/16"	1/2"
3/4"	5/8"	11/16"	1/2"
1"	13/16"	13/16"	9/16"

Fig. 3. Pressure connections should be made carefully using the welded type (left) for pressure over 200 lb. ga. or when the pipe wall thickness is less than dimension C

CENTERING: The metering element must be concentric with the internal pipe diameter. Do not attempt to center with regard to bolt circle or edge of flange since these are usually not concentric with the internal pipe diameter. Use the method shown in Fig. 2. Centering the primary element is especially important in the case of eccentric or segmental orifices which are often provided with centering pins.

DIRECTION: It would seem superfluous to specify that the orifice or

CORRECTION

We regret to have to announce a serious error which occurred in our presentation of Part III of this article on Flow Meter Installations in the December issue. The cuts above the captions in Figs. 1 and 4 were transposed. The illustration shown on page 95 as Fig. 4 actually is Fig. 1. Similarly, the illustration shown on page 92 as Fig. 1 actually is Fig. 4. We trust that this correction note will serve to dispel the confusion the transposition may have caused.

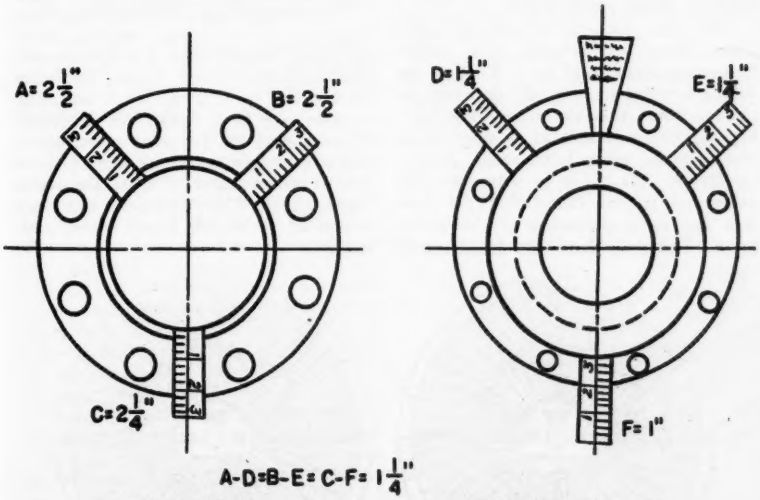


Fig. 2. Directions for centering the orifice in the line between flanges.
In centering the orifice, the most convenient measuring point is the outside circumference of the pipe flange, but this is often eccentric with respect to the internal circumference of the pipe itself. To eliminate this possible error, three equally spaced measurements (as shown in left-hand illustration) should be taken between the INSIDE surface of the pipe and the OUTSIDE of the flange. The orifice plate should then be inserted and another set of dimensions taken AT THE SAME LOCATIONS, but between the OUTER edge of the orifice plate and the OUTSIDE of the flange. Shift the orifice until the DIFFERENCE between the first and second set of measurements for each location is the same for all three locations. (A minus D = B minus E = C minus F.) The orifice will then be centered with respect to the inside diameter of the pipe.

[1]Part I, Why, When and Where Flow Meters are needed appeared on pp. 88 and 110 of the October issue; Part II, How Flow is Measured, appeared on p. 97 of the November issue; Part III, How to Select Primary Elements and the Most Desirable Differential appeared on p. 92 of the December issue. Part V, How to Pipe the Flow Meter, and the concluding installment, will appear in a subsequent issue.

This series of articles considers only practical flow meter use and installation for those reasonably familiar with general theory and construction. For a complete development of the theory and a comprehensive treatment of fluid measurement the author refers interested readers to the publications of the A.S.M.E. Special Research Committee on Fluid Meters. These are available in three separate volumes: Part I on theory and application covers the classification of all types of fluid meters, develops the theory, gives physical constants and meter coefficients and includes an extensive bibliography. Part II describes the individual makes of meters (both primary and secondary devices) in commercial manufacture. Part III covers selection and installation. These are available from the American Society of Mechanical Engineers, 29 West 39th St., New York City, at the following prices: Part I, $3.00; Part II, $1.75; and Part III, $1.50.

[2]For mechanical reasons Fig. 1, a full page chart showing proper methods of installing the orifice or flow nozzle, making pressure taps, locating valves, piping and reservoirs for steam, liquids, gas and air, is placed on the last page of this section.

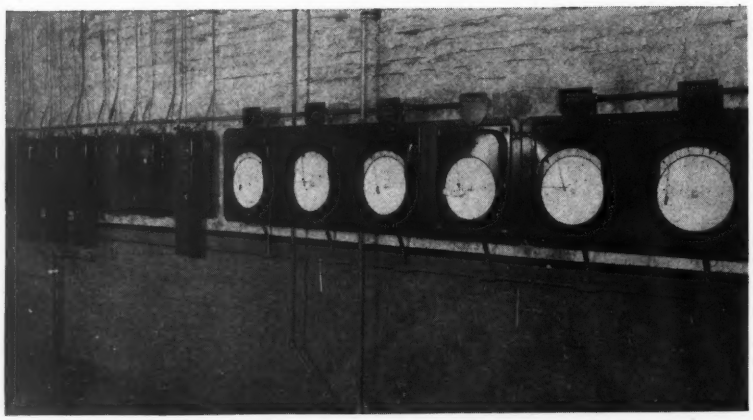


Fig. 4. A well laid out battery of flow meters on distribution lines at the McCormick Works of the International Harvester Co.

nozzle must be installed in the proper direction were it not for occasional installation errors on this point. The orifice plate must have its sharp square edge upstream and the beveling (if any) downstream. The flow nozzle must, of course, point in the direction of flow with its throat downstream.

DRAIN HOLE: The drain hole must also be properly located, flush with the bottom of the inside pipe wall for steam, gas or air measurement, flush with the top of the inside pipe wall for water measurement, and on vertical installations at least 90 deg. from the pressure taps, around the circumference of the pipe.

GASKETS: Special care should be used in cutting the gaskets between the orifice, or nozzle, and the flanges so that they do not project into the pipe and interfere with the flow through the orifice, nozzle bore, or, drain hole.

FLANGES: When using screwed flanges, the pipe must be screwed into the flange so that the end of the pipe is flush with the inside face of the flange. When using welding neck flanges, make certain that no welding material projects into the pipe at the union of the flange and the pipe. Also file the inside of the joint until all excess weld material and burrs are removed, so that the pipe presents an unobstructed path for the fluid.

Pressure Connections

In installing the pressure connections in the pipe line, the directions listed below must be followed exactly. Any deviation will result in the transmission of the wrong differential to the meter mechanism which in turn will record incorrectly.

1. Select from the sketches in Fig. 12 the one corresponding to the kind of fluid to be metered (steam, liquid, gas, air, etc.); and the pipe direction (horizontal, vertical, inclined, etc.) of the proposed installation.

2. Measure the Upstream (U), the Downstream (D) pressure tap dimensions from the upstream face of the metering element accurately (to within 1/32 in.).

3. Install pressure connections both into the same side of the pipe, using one of the two methods illustrated in Fig. 3. The welded coupling style is to be used when the pipe wall thickness is less than C, given in the table, or, when the pressure exceeds 200 lb. ga.

4. Special care must be taken so that all the burrs, made by drilling the pressure holes, are completely removed from the inside of the pipe.

5. When using nipples threaded directly into the pipe, it must be certain that the nipples do not extend into the pipe. Center punch the nipples 1 in. from the end. When the nipple is screwed in place the distance between the punch marks and the outside of the pipe, plus the pipe wall thickness, should never be less than 1 in.

6. Nipples must be installed at exactly right angles to the axis of the pipe and level horizontally, or plumb vertically as the case may be.

7. Bent nipples and the straight vertical nipples used in vertical pipe lines must be lagged as shown in the installation sketches which follow. Do not lag any other connections unless specifically instructed to the contrary.

8. Where long lengths of connecting piping are attached to the pressure connections, provide auxiliary supports for holding these lengths, otherwise there will be danger of tearing the nipples out of the pipe line.

9. Shut-off valves should always be provided directly after the pressure taps.

10. Use good pipe compound sparingly on all connections, making sure that none gets into the pipe itself.

11. When reservoirs are used, these must be exactly level in all cases. Use reservoirs for water of 250 deg. F. and over to provide storage of comparatively cool water in sufficient volume to replace water drawn into the manometer. Thus the temperature and density of each leg of connecting piping is kept even or balanced.

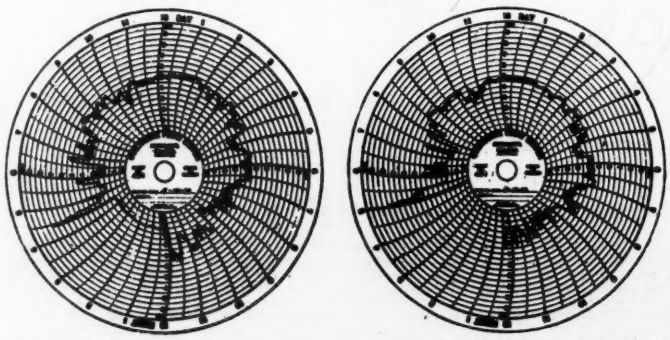
Meter Detects Steam Losses

FLOW METER records, properly analyzed, can be used effectively in the control of steam use and the detection of waste. This point is emphasized in two recent installations where night losses were detected and an appreciable saving made in steam consumption.

The two records reproduced were taken from a Cochrane flow meter measuring steam sold by a hotel to an adjacent restaurant. It will be noted on the top chart that the steam flow continued after midnight at a time when there was no steam being used. An investigation was made to determine the cause and it was found that the flow was due to condensation in the steam lines. The daily loss was $1.02 worth of steam, but was eliminated by closing the steam valve on the inlet each night after the demand ceased. The bottom chart shows the difference.

During the heating season it was necessary to leave the steam valve open all night, but during the months from May to September inclusive, the valve is kept closed and the savings of a single heating season were estimated at $153.

In another case, in a hog-killing department of a Chicago packing plant, the meter record showed a considerable consumption of steam during the hours of 6 p. m. to 6 a. m. when no steam should have been used. An investigation disclosed the fact that steam leaked into a hot water heater all night because the workmen failed to close the steam valve tightly. Daily loss from this cause amounted to 111,600 lb. of steam, costing $33.



Steam flow charts before and after the line valve was closed during night periods to save $153 of steam per season

How Would You Do It?

Problem 25. The strange case of the two vats. American genius responds, and howl

SHADES of Captain Morris! What happened? What was there in those two vats to bring forth such a flood of answers? Our Hero certainly let us in for a lot of trouble when he walked in with that innocent looking problem 2 mo. ago and if he dares to give us another one like it, "we'll mow him down, so help us".

The members of the Board of Judges are still in a state of acute jitters bordering on complete collapse. Aside from the strain of sorting out the letters, the multiplicity of weird contraptions suggested was all but too much for their feeble brains and several of the old guys are now engaged in a futile attempt to build them. Two of them were caught red-handed removing strange looking gadgets from the city scrap pile. When apprehended they seemed to be talking gibberish of a low order, and were trying to find their way to Rube Goldberg's house. The chief justice in an attempt to prove something or other had two

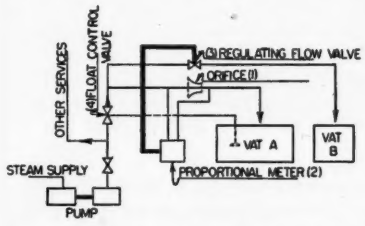


Fig. 1. Mr. Calvert's solution. First prize

vats brought to his chambers from a local wine dealer and he and several of his cronies were found emptying the liquid contents of said vats.

Whatever else Problem 25 may prove it shows that when a large enough group of people are put to work on a problem plenty of different kinds of solutions will be forthcoming. When we put Our Hero's problem up for discussion we felt that it was a comparatively simple one and that there were only a few ways of solving it, but, O, Boy, how we were mistaken! Strangely enough, the first letter that was sent in and which reached us on November 5, insisted that the problem was too simple. It began "What's the catch? This problem seems too simple", whereupon the contestant solved it simply by running a 3-in. pipe to the large vat and a 2-in. pipe to the small vat.

The problem is not as simple as that however. A much more effective and practical way is to insert orifices in the respective lines to the two vats so proportioned that the flow into the large vat will be just twice that into the small vat, and it is of interest to know that approximately 50 per cent of all the solutions submitted were of that variety. This scheme, undoubtedly, would work and when properly associated with one or more float controls to start and stop the flow provides the simplest system.

As pointed out by no less a personage as the ex-editor of the Practical Engineer section, Captain Morris who sent in a solution, both of the orifices would be subject to the same pressure variations and the relative size of the orifices could be calculated without a great deal of trouble.

Representative of this class of solutions, is the one by Rollin Lager and which was awarded second prize. Many other contestants submitted essentially the same solution and the award to Mr. Lager was made on the basis of the clarity of his letter, on the completeness of the data presented and upon the fine diagram he submitted.

Many contestants suggested the use of an intermediate tank or pressure chamber to eliminate the pressure variations caused by varying loads on the pump and to proportion the flow to the two vats. In some instances, this intermediate tank was provided with two wiers to proportion the flow. Such an arrangement also would work, but the conditions surrounding the installation might be such as to preclude the use of such a tank. There might not be enough head room or it might be too expensive to install. Nevertheless, this method deserves serious consideration.

Fundamentally, however, this is a problem in split-feed control and it is most effectively accomplished by the use of some kind of proportional controller. Curiously, however, only two contestants mentioned the use of such controllers and one of these was the first prize winner, Julian P. Calvert. Mr. Calvert's solution shown in Fig. 1, is simple and effective and accomplishes all the requirements with a minimum amount of changes and except for the proportional meter, is inexpensive.

There is another way of doing it, but not a single one of solutions submitted use it, although Mr. Calvert came very close to it. This is the arrangement shown in Fig. 2. Here, the flow is proportioned automatically by means of a 3-way valve so as to assure a certain percentage of the total flow going to each of the two lines leading from the main supply.

One of the instruments measures the flow through one branch of the system and controls the flow to the pump. The second branch is under the control of the second meter and permits only a certain amount of fluid to flow through this pipe, the remainder flows through the first line; and if too much or too little is available, the pump speed is automatically

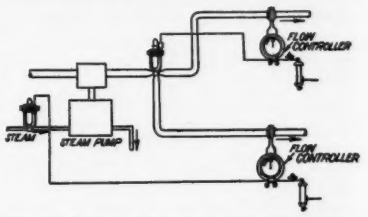


Fig. 2. System using two proportional flow controllers which none of the contestants submitted

changed. As a result the entire system is in balance. Both controllers must be of the proportional-and-floating type in order to prevent serious cycling of the system.

Now, let us see what the prize-winning solutions look like.

FIRST PRIZE AWARD
Julian P. Calvert
Flushing, N. Y.

In the diagram (Fig. 1) (1) is an orifice selected to suit the variable head pressure between the suspected possible limits, (2) is a proportional meter that takes the impulses of the differential pressure drop across orifice (1) and governs the flow mechanically through (3) the regulating flow valve. (4) a float controlled valve setting the maximum

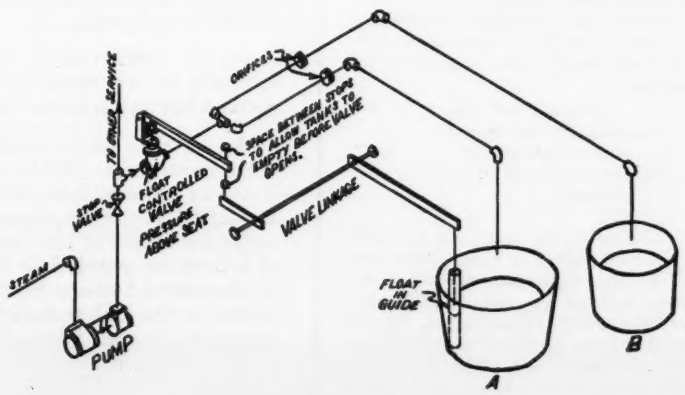


Fig. 3. Rollin Lager's system. Second prize

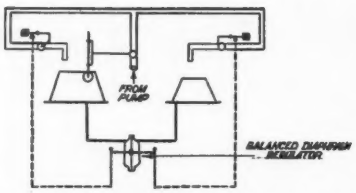


Fig. 4. Scheme outlined by Mr. Leopold. Third prize

height of liquid in vat B, thus automatically setting the maximum height of liquid in vat A.

SECOND PRIZE AWARD

Rollin A. Lager
Milwaukee, Wis.

My sympathy was so acute when I read of the disappointment of the judges at not receiving any answers to last month's problem that I decided to make sure that they would receive at least one answer to this month's problem.

As I see it, Our Hero's problem is one of metering. The use of a float operated valve, homemade or otherwise, will solve the problem of starting and stopping the flow.

About the simplest metering device known is the sharp-edged orifice, therefore, I suggest installing an orifice between sets of flanges in the line to each tank. The area (not diameter) of the orifice in the line to the large tank must be twice the area of that in the line to the small one. They should be placed so that the pressure on the pump side of each orifice is equal. This also entails using pipe sizes such that the pressure drop from the point to take-off from the main header to the outlets is equal or approximately so. There should be several feet of straight pipe ahead of the orifices. The variation in the pressure in the main pump discharge header will affect both orifices equally.

Apparently the time required to fill the tanks is not set; it will be governed by the pressure in the pump discharge header. Since no information is given regarding capacities of the tanks, and desired rate of filling Our Hero will have to do a little experimenting with the orifices until the desired rate of filling is obtained. It would be best to start with orifices a trifle too small and increase the sizes as necessary to secure the desired rate of flow.

To help Our Hero figure the approximate size of orifice to use, the capacity of a sharp-edged orifice is given by the formula:

$$Q = 0.61\ A\sqrt{2gh}$$

Q = cubic feet per second
A = area in square feet
h = pressure ahead of orifice in feet of water
g = 32.2

The flow to the tanks can be easily started and stopped by using a float controlled valve with space enough in the linkage to allow the tanks to empty before the valve is opened again. It will only be necessary to use a float in one tank unless there is a possibility of the tanks being emptied separately. If the orifices are properly made twice as much water will flow into one tank as the other in a given length of time.

Our Hero will probably be happy to know that an expensive governor will not be necessary unless he is interested in always filling his tanks at the same rate.

A little sketch of the necessary hookup is shown in Fig. 3.

THIRD PRIZE AWARD

Henry Leopold
Supt. Southern Extract Co.
Knoxville, Tenn.

Ed. Note. Mr. Leopold did not submit a sketch, but the system as described would look something like that shown in Fig. 3. The connection between the diaphragm regulator and the two valves may be mechanical, electrical or hydraulic.

1. I would install a spring loaded diaphragm lever valve at the bottom of the two vats. I would connect the top side of the diaphragm valve to the larger or higher vat, and the bottom side of the diaphragm valve to the smaller or lower vat.

2. I would install a balanced lever valve in the water line leading to the larger vat and a balanced lever valve in the water line leading to the smaller vat. The valve leading to the larger vat having twice the capacity of the valve leading to the smaller vat, I would connect with levers the two balanced water valves to the spring loaded diaphragm valve in such a way that when the pressure from the larger vat exerted pressure on the top side of the diaphragm it would tend to close the valve leading to the said vat, and connect the smaller valve leading to the smaller vat so that when the pressure from said vat exerted pressure on the under side of the diaphragm it in turn would tend to close the balanced water valve leading to the same vat. I would adjust the spring on the diaphragm lever valve to compensate

Problem 26

DOES THE 65 DEGREE RULING SAVE FUEL?

WELL, here we are again. Our Hero dropped in the other day to see how the answers to his two vat problem were coming along and after we had finished telling him what we thought of that blankety-blank problem we decided to forget it and listen to a new problem he had on his feeble mind.

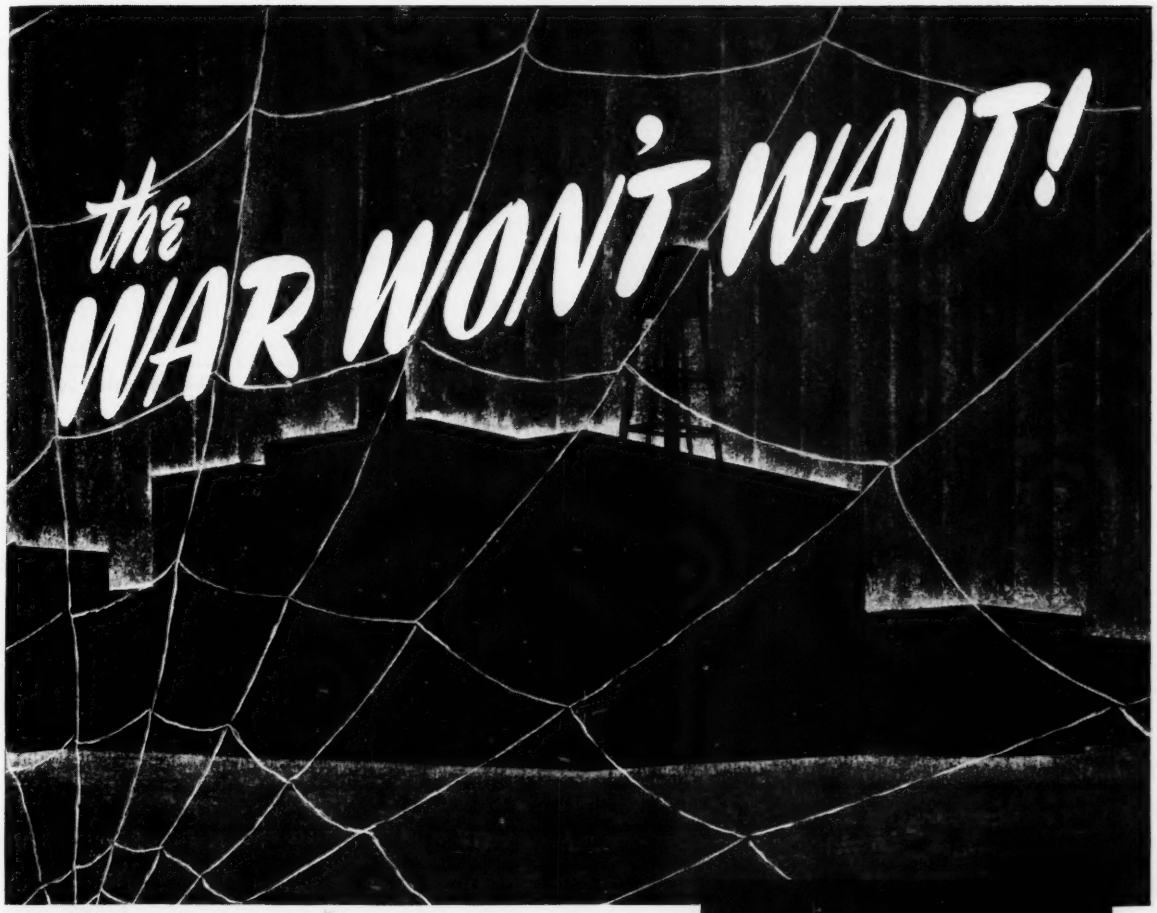
He was worried, of all things, about fuel rationing. Several days before he had met our old friend A. H. Parker, the capable engineer of Peterborough Hospital in Peterborough, N. H., and Mr. Parker, it seemed, was in a quandry about the 65 deg. regulations. He wondered whether it would be too much to ask for a discussion of this subject in these pages.

A good many people, Mr. Parker pointed out, are in doubt about it; many of them say that keeping the temperature at 65 deg. or lower does not save a cent. An authority like the Bureau of Mines however, claims that such a lowering of temperature does effect an appreciable saving. Also, what merit is there in lowering the temperature at night and then raising it again the next morning? Mr. Parker says that his own experience leads him to conclude that when the fires are reduced for a time in an effort to save fuel, it takes as much more fuel to bring the temperature back to normal.

An arbitrary ruling that a temperature of 65 deg. or less shall be maintained, means, in his case, and no doubt, in many others that end rooms get no heat at all. He says that he has just had a radiator split for that very reason.

As Mr. Parker told our Hero, it was not that he was not wholeheartedly for any measures, no matter how drastic, that patriotism decreed but he wanted to have facts rather than guesses.

So our Hero talked us into putting the problem up for discussion in this department. What is your opinion of the 65 deg. ruling; does it save an appreciable amount of fuel or not? Discuss the matter from a practical, engineering standpoint in a letter of not more than 1500 words and send it to the Contest Editor by January 31. A first prize of $15 will be awarded for the best letter; a second prize of $10.00 for the second best and a third prize of $5.00 for the third best letter. Entries in this contest should be marked Problem 26 and should be addressed, Contest Editor, Technical Publishing Co., 53 W. Jackson Blvd., Chicago, Ill.



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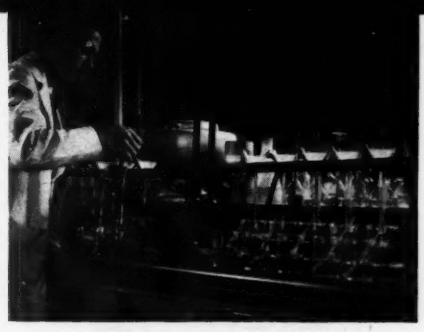

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for the differential in pressure of the weight of water in the two vats.

3. I would install a balanced float valve in the main water line leading to the two vats and connect to a float in one of the vats so that when the vats were full the valve would cut off the water going to the two vats.

4. I would place a back pressure valve in the service line leading to other services so that I could maintain a constant pressure in the line leading to the vats to insure a given time to fill the vats each time they were employed.

5. I would install a pump governor on the pump to maintain a given pressure in the water line.

6. I would place a pump speed governor on the pump to maintain a given piston speed in case the water demand was more than the capacity of the pump. I think this arrangement would make the operating conditions 100 per cent perfect.

DUPLICATE THIRD PRIZE AWARD

Harrell Denmead
Pittsburgh, Pa.

This scheme is to insure filling of the two tanks to the top simultaneously, but off supply when full, and refilling after both tanks are empty using All-Electric Floatless Liquid Level Control Relays manufactured by B/W Controller Corp., Birmingham, Mich. Referring to sketch the operation is as follows:

The laminated core of the A shaped magnetic path has a coil X on top as shown in sketch. This coil is always energized from 110 v. a.c. So long as the lower coil Y is open there is no magnetic attraction to the armature Z. As soon as the lower coil Y is shorted, a bucking action is set up causing the magnetic line of force to go down the legs of the relay and attracting the armature Z operating relay.

With the tanks empty contacts 7 and 9 of relay C are made and contact 8 is open. Contact 7 complete coil circuit to valve A allowing water to flow into large tank. As soon as large tank is half full, electrode No. 2 is made which operates relay D causing contact 6 to close operating valve B which allows water to flow into small tank. Assuming that supply to both tanks is the same when both valves are opened, the two tanks should then fill at same time. To insure no overflow valves A and B are shut off when electrode 1 or 5 or both are reached by water by operation of relay C. Relay C then seals in by contact 8 and stays sealed in until electrode 3 and 4 are out of water. Contact 10 of relay C opens discharge valves E and F when tanks are full. Opening of contact 10 allows valves T and F to close when tanks are empty.

I take from the statement in the problem that steps would be taken to regulate the pump.

The piping should be arranged so that with A and B valves open, equal amounts of water would be supplied to each tank regardless of fluctuating supply from the pump. See sketch.

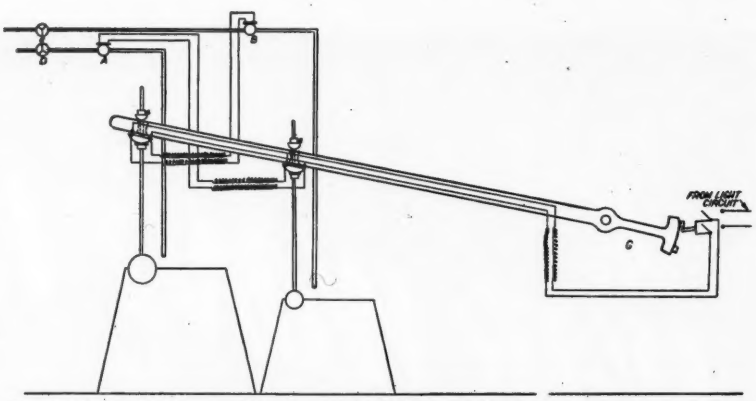


Fig. 6. The system proposed by George McNally is similar to the one suggested by Mr. Terrien in Fig. 6, but it operates the valves electrically

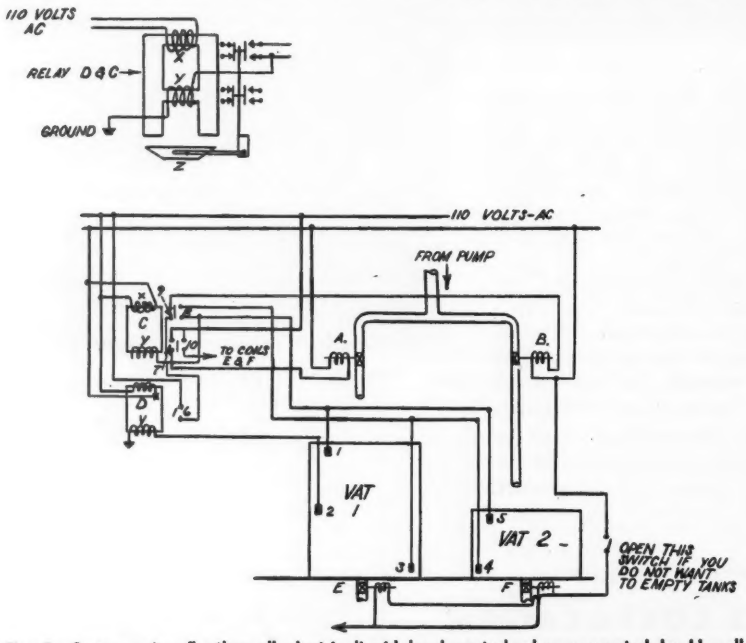


Fig. 5. System using floatless all electric liquid level control relays suggested by Harrell Denmead. Duplicate third prize

Coil X on the upper bar of the core is always energized. When lower coil Y has circuit closed through electrodes, armature Z is pulled up, operating contacts

Note: Auxiliary relays to relieve duty on contacts of relays C and D, may be necessary

A, B, E, F,—Spring closed, solenoid opened valves

1, 2, 3, 4, 5—Electrodes

6, 8, 10—Contact made when relay coil Y is shorted

7, 9—Contacts made when relay coil Y is open

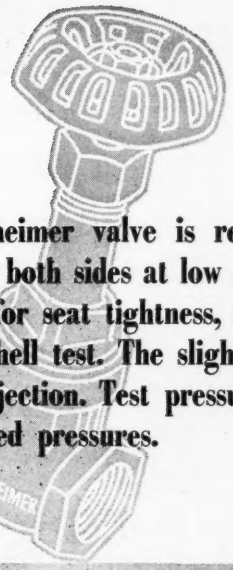
General Comment On Prize Winning Solutions

It will be seen that each of the four prize-winning contestants attack the problem in a different way. The simplicity of Mr. Calvert's solution should appeal to any true advocate of automatic control, because it achieves all the requirements of the problem simply, effectively, and scientifically. Mr. Lager's very practical and inexpensive system probably would do the work very nicely and it could easily be rigged up from material at hand. Mr. Leopold's scheme is ingenious and on paper at least offers an interesting solution to the problem, but it would entail considerable adjustment of the regulator and the valves to make it work properly: but it is a nice solution.

Mr. Denmead's system is unique in the interesting type of electric level control relays that it uses. This system also should work, but there is one point in which this solution does not meet the requirements of the problem. That is in the fact that he first fills the large vat to the level of the small vat and then the two vats are filled to the top at the same rate. Under certain circumstances this might not be permissible, but his system of relays is so different from that of any others presented that the judges felt justified in awarding him a duplicate third prize.

Comment On Other Solutions

It was extremely difficult to decide on the prize winners in this particular contest because of the many interesting letters received. There is not space



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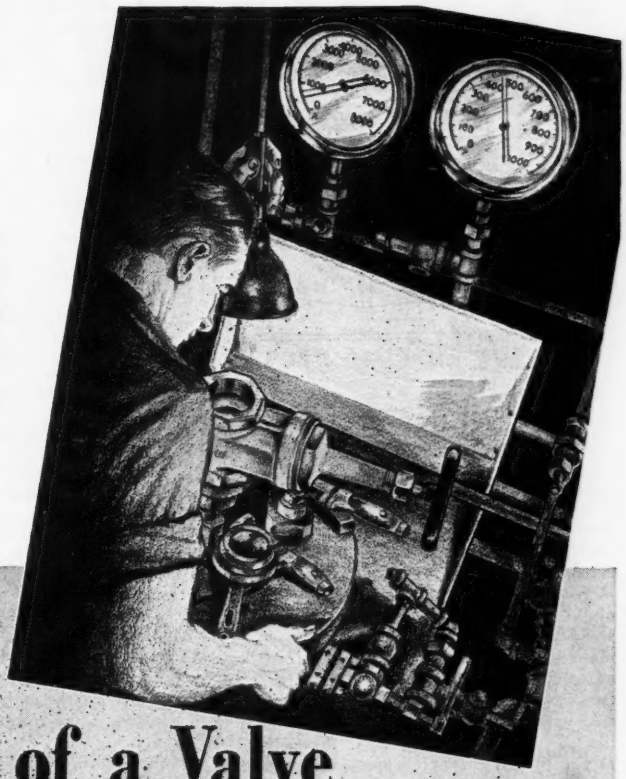

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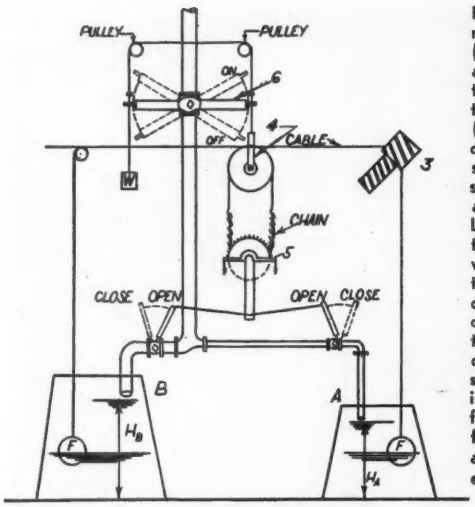


Fig. 8. Here is how S. S. Headman solves Our Hero's problem. (1) Vats. Different sizes and on any level. (2) Floats in each tank travel from limit positions of full to empty equal to H_b and H_a. (3) Differential spool. Ratio of dia.-H_a/H_b. (4) Floating double sheave block with yoke. (5) Fixed sprocket with short length of chain attached to cables from floats. Lever arm with connecting rods to operate plug cocks feeding vats. Cocks can be proportioned to suit flow to make balanced operating unit. (6) Main control cock actuated by tappets on cable throws balanced weight each side of center line thereby giving quick shut-off. Movement of sheave (4) is one-half of movement of either float in vats. (7) Operation is fully automatic and can be made at less than cost of pump governor which has nothing to do with the problem

available to comment on more than a few of the other letters, but we will consider as many as possible.

Figure 7 shows an interesting scheme proposed by A. D. Terrien of Hammond, Indiana. It consists of two floats in the respective vats connected to a sort of compensating mechanism operating a two-way valve in the supply line to the two vats. On paper, at least, it works nicely. As A moves to B, C moves to D and the same thing happens in vat Y.

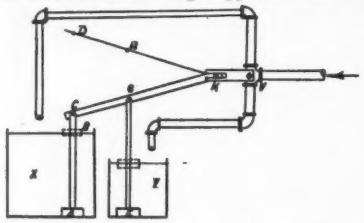


Fig. 7. Mr. Terrien's scheme

If the tanks fill at proportional rates the point K will not move, but if the level in one vat gets ahead of that in the other, point K will move and operate valve V to regulate the flow. As shown there does not seem to be provision to start and stop the flow of water but that could easily be added.

A similar scheme was proposed by George McNally of Kearny, N. J., but he utilized electrically operated solenoid valves in the feed lines, controlled by sets of contacts on lever arm. The scheme is shown in Fig. 6. The float rods carry a pair of discs of fibre rounded on the bottom to permit their assuming the proper position as the lever moves up or down. A pair of leads from each of these discs leads to a solenoid valve as shown. As the water flows into the vats these floats will rise and will lift the long arm up with them.

Should one vat tend to fill faster than the other the lever will be lifted free from the contacts on the float control of the *other* vat and immediately the solenoid valve will close on the tank which is gaining and will stay closed until the other float rises to again make contact. When both vats are full the limit switch is opened by the end of the lever thus closing both valves and allowing the vats to be emptied. The valves must remain closed until the lever has reached the lowest point when the limit switch again kicks in and opens the valves for filling.

This solution by Mr. McNally is extremely ingenious and deserves praise. As he points out, the addition of a pump governor would not affect the filling of the vats.

Another solution which deserves comment is the one sent in by Sidney A. Miller of Philo, Ohio. Mr. Miller is assistant chemist at the Philo plant of the Ohio Power Co. and his answer is based upon an actual system in use at one of their plants. Quoting from his letter, "I believe that a lime feeder now in operation at one of our affiliated plants is the answer to Problem 25.

"The steam pump is in continuous operation in order to supply other plant needs. The two hot water lines feed directly into separate constant head boxes in which the level is controlled by means of float valves on the ends of the feed lines. In each of the effluent lines from the constant head boxes to their respective vats there is a variable orifice valve and a solenoid operated shut-off valve.

"Each vat is equipped with a vaporstat level control and a dry-lime feeder. When the vat becomes empty the vaporstat opens the solenoid valve and also starts the dry-lime feeder. By setting the variable orifice valve it is thus possible to control the speed at which the vat fills and to obtain the desired concentration of lime slurry.

"In order that the vats fill simultaneously the low level contacts of the two vaporstats will have to be connected in series. Thus the filling operation will start only when both vats have become empty. By adjusting the variable orifice valves, the flow of hot water to the large vat can be made twice the flow to the small vat.

"The above layout is (1) completely automatic, (2) supplies hot water to the large vat twice as fast as to the small one, (3) fills the two vats simultaneously, and (4) automatically feeds dry chemicals to make a batch of desired concentration."

Figure 8 shows how S. S. Headman of Phoenix, Ariz., would tackle the problem. Mr. Headman evidently is an ingenious chap because his arrangement involves almost every type of mechanical device and gadget known to mechanical science. It is an interesting solution, however, and as Mr. Headman points out, it could be made at less than the cost of a pump governor, which incidentally, he says has nothing to do with the problem. He thinks the pump governor could be used to better advantage if applied to the engineer when the blond stenographer from the front office comes into the plant.

And, now, we come to the *coup de grace* with Ammonia Leeks' classic solution or solutions since he has several suggestions all of which are equally cockeyed in our opinion (Fig. 9). He also failed to submit a picture but Anita Stewart, our capable young woman draftslady drew one for him. She did him more than justice, don't you think?

"The obvious solution," says A. Leeks, Esq. (who really is Harold Sykes of Flagstaff, Ariz.), "is to find two pipe sizes, so that one will always deliver exactly twice the flow of the other. Area and friction weren't so bad, but the friction in my brain was the unknown factor. I got my slide rule all out of joint when I tried to find two *standard* pipe sizes, so that one would always fill the large

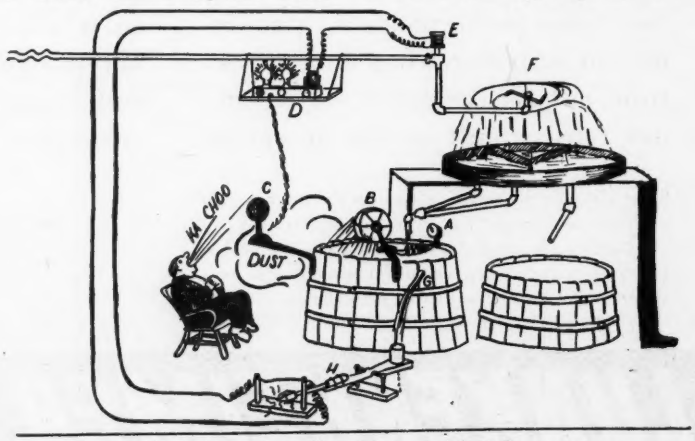


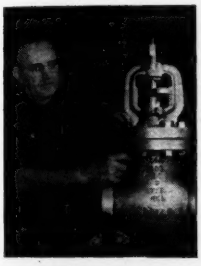
Fig. 9. This is Ammonia Leek's solution, confidentially, - - - - -

COMPACT VALVE CATALOG

Veteran Edward Workers Keep Quality High

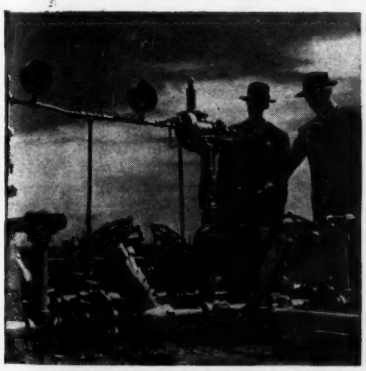
"KNOW HOW" LEARNED BY EXPERIENCE

Increased war production has brought no lowering of exacting peace-time standards at the Edward plant, for the Edward personnel is well seasoned with veterans who have the valve building "know how" gained from years of experience.



PAUL NIEMETZ, a 22-year veteran, assembles a 600 lb Edward cast steel valve

Scarcely a department in the Edward plant is without men with 20 years or more experience building Edward steel valves. To the buyer, this is important. It means that the Edward policy of accurate workmanship, rigid inspection and complete laboratory control will be maintained in such a way that today's Edward valves will be just as dependable and long lived as always.



TYPICAL REPRESSURING hook-up in Texas oil fields uses Edward Fig. 158 valves. These forged steel valves, for hydraulic and gas pressures to 6000 lb, are used in many services.

NO GUESSING—

Edward engineer checking the diameter of a plug gage on 48 in. Pratt & Whitney measuring machine which permits readings to 0.00001 in. Thread comparators, light wave measuring units, comparison blocks and other high precision equipment in the air conditioned Edward Bureau of Standards substitutes exact knowledge for guesswork in building Edward valves.

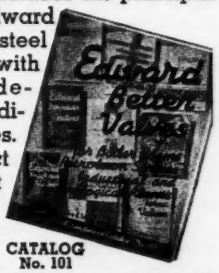
All working gages in the Edward plant are checked at regular intervals to insure constant accuracy.

Edward No. 101 Streamlined to Save Your Time

A POST CARD BRINGS YOU THIS HANDY BOOK

To simplify war-time purchasing, Edward is offering a streamlined, fact-packed and easy-to-use BETTER VALVES Catalog No. 101.

This catalog includes the principal valves of the Edward cast and forged steel line, complete with illustrations, descriptions and dimensional tables. Yet it is compact enough to fit easily into your desk drawer or brief case.



CATALOG No. 101

If you haven't a copy, a post card will bring you one promptly. Just ask for BETTER VALVES Catalog No. 101.

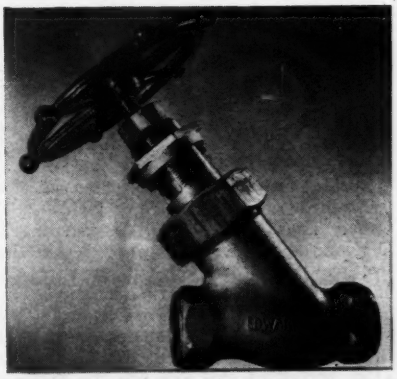
EValloy Adds Life to Vital Parts of Edward Stop Valves

DESIGNED FOR SURE, EASY OPERATION

Long life, sure shut-off and free flow are important features of Edward forged steel globe and angle stop valves.

Parts subject to greatest wear are made of EValloy, Edward's specially developed stainless steel which is exceptionally resistant to corrosion and erosion.

The forged and heat treated full area bodies are contoured for maximum freedom of flow, yet the basic design of Edward stop valves is such that positive, drop-tight closure is assured.



EDWARD FIG. 2688, forged steel, O.S.& Y. globe stop valve for 600 lb service. Same valve of inside screw construction is Fig. 2698. Both are built in ¼ in. to 2 in. sizes, and in angle design as well.

THE EDWARD VALVE & MFG. CO., INC.
220 WEST 144th STREET . . . EAST CHICAGO, INDIANA

EDWARD *Steel* VALVES
CAST AND FORGED

vat in the same time that the other pipe filled the small vat. In spite of anything I could do, one vat would run over before the other one was full, and steel companies are too busy to make pipe of special dimensions, even for Our Hero.

My next inspiration was that Our Hero ought to fire the present operator and put the Office Blond in charge of the two valves. But I knew that would be too simple a solution for him to consider.

Nextly, I got the Office Mechanic here to help me build two vats. We raised the foundation of the smaller vat so that the top was on a level with the top of the large one and connected them just below the full mark with a pipe of outside dimensions. Then, whichever vat filled first, it overflowed into the other one. But, alas, upon reading the conditions of the problem again, we found they are chemical mixing vats. So, to find out if that mattered, we raided a couple of drug stores for chemicals and poured them in the water. They mixed, via the common connection, and blew the whole thing sky-high. Maybe it was the wrong combination.

As soon as I had explained to my boss that the ceiling had been lifted, he returned to his books and priority forms, muttering that it sure was getting to be an all-out war.

Then the Office Mechanic came up with this suggestion: Tap the pump discharge line to the other services with a single pipe which delivers onto a water wheel composed of 3 (or 6 or 9) lard buckets suspended from spokes of the wheel by baling wire. Mount a cam on the wheel shaft so that it will operate a rod to trip every third bucket and spill it in the smaller tank. The other buckets, not being tripped, would discharge into the large vat. (His brain works on the haywire principle.)

Then I emerged with the following: Use a single pipe to discharge into a distributing basin above the two vats. This basin would be a small closed metal tank with three evenly spaced holes of equal size in the bottom. Then pipe from two of the openings to the larger vat and from the third opening to the other one.

Then, referring to p. 132 of the November issue of P.P.E., I showed the O.M. an ad of a butterfly valve to control any liquid at most any pressure. It was but the work of a moment to attach a sliding float on a rod so that it would shut off the flow at the top and open it at the bottom of its travel. The O.M. announced that this was the first suggestion from me that made any sense whatever, but after we had broached a couple of phials of fizz-water, we decided to turn in a solution to end all solutions. Here it is, a la Rube Goldberg:

When the vats are empty and drying out a humidity control A operates to start an electric fan B which blows a cloud of dust up out of the vats. This causes the operator to sneeze. Sound of sneeze impinges on microphone C, causing current to flow to amplifier tubes D, which startles them into shooting a sudden slug of current to operate a relay. Relay operates a solenoid liquid valve E, which opens in a single branch line from pump to a point above vats. Pipe discharges into whirling lawn sprinkler F. Small tank built around sprinkler catches the water. Tank is divided with three equally spaced radial partitions, making three similar pie-shaped sections. Two sections are connected to large vat and the third to small vat.

As soon as vats start to overflow, water runs out of overflow spout G and some of it fills a small can (with very small hole in it, to drain it later). This can is on a balance arrangement. As can fills and descends it raises other end of balance and lifts handle of hot soldering iron. Said iron is pivoted at mid-point, so that tip will ascend and encounter length of fuse wire in solenoid circuit.

Iron melts fuse, allowing valve to close and stop water flow. The O.M. pointed out that the only slight flaw in this otherwise perfect set-up is a lack of any yet conceived way of feeding additional lengths of fuse wire automatically, so as to restore the solenoid circuit for the next cycle. I'm working on that now. In the meantime possibly the present operator could remember to do this, if the blonds are not too prevalent.

Ed. Note: In view of the unusual response to this problem we will present several more of the solutions in the next issue.

Questions And Answers

Question No. 209

What Makes His Oil Foam?

I AM using an engine oil in the bearings of a synchronous converter running 1200 r.p.m. and it seems to foam when the oil rings start to turn and the machine gets up to speed. I do not know whether this is a condition of this particular oil or whether it is due to some mechanical condition in the machine. What would you say caused it? Should oil do this in bearings? These sets are rated at 200 kw.

Albert, W. Va. FRED HARTMANN

Question No. 210

Looks Like Something Rotten in Denmark

WE RECENTLY installed a bank of new transformers on our lighting system. The old ones were being badly overloaded, being rated at 15 kw. 2200-v. primary, 115-v. secondary with the split secondaries wired in parallel. The bank consisted of 3 single-phase units. The power factor of the system with these units was from 95 to 97 per cent most of the time. We have a 150-hp. synchronous motor driving a 100-kw. d.c. generator and a 175-hp. synchronous motor driving a Frick ice machine.

The new transformers are rated at 25 kw. each, but since they were installed the power factor dropped to 75 to 85 per cent and it became necessary to cut down on the exciter voltage of the motor generator set to correct the power factor to its former value. The primaries of the transformers are connected directly to the 2300-v. line between the oil circuit breaker and the power company's cutout.

What I want to know is this: What caused the drop in power factor when these new units were connected?

When the power to these new units was first cut in, one pilot light in the demand meter went out and the recording pen went clear across the chart and stayed there. One pilot light in the watthour-meter also went out. What caused this?

I am not the electrician, but I asked him why one transformer was warmer than the other two, but he could not answer me.

Buffalo, N. Y. ROBERT BAKER

Question No. 211

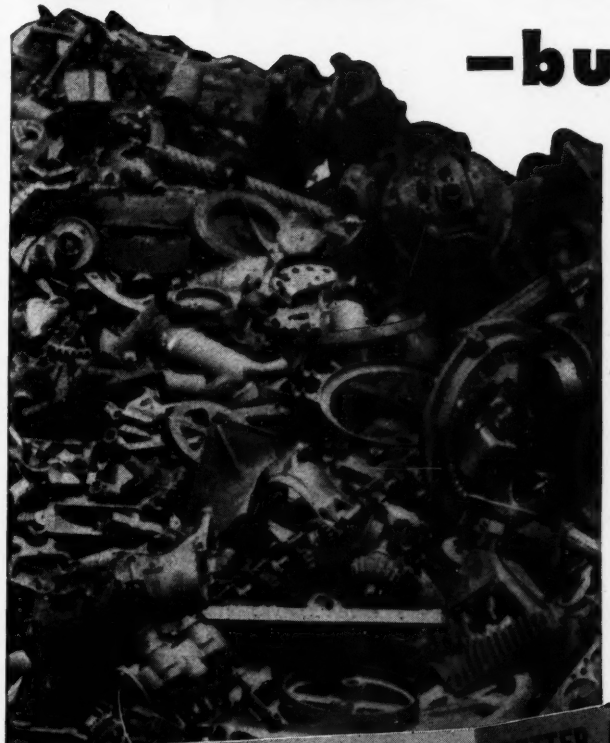
High-Speed Conveyor Operation

WE RECENTLY put in a rewound motor that had been burned out. This is a 17-hp. 970 r.p.m. shunt wound, d.c. motor driving a coal conveyor in the power plant. We got it mounted and when the plant electrician wired it up and threw the starting switch, it really started. I never saw a coal conveyor travel so fast. The roof shook like a young earthquake and the buckets were just a blur. We stopped it in time. So the electrician tried again—he changed the connections and threw the switch once more. This time it ran backwards but not at high speed. With the third trial he evidently got his brain to working and figured it out because then the motor ran as it should.

I would like to know what made the motor go so fast. The motor itself sounded like the whine of a high-speed shell. I looked up the subject of shunt wound motors in my books but could find nothing that sheds any light on this question.

Buffalo, N. Y. ROBERT BAKER

LET'S GET IN THE SCRAP
—but not make it!



"Piping Pointers" Show You How To Reclaim Valves

THE steel mills need all the scrap they can get. But, first salvage all readily usable equipment when practical. Every reclaimed valve, for example, means that another new one is available for essential war industry—that another valve is on hand to keep production lines flowing. For practical, valuable hints on reclaiming valves, get a copy of this Crane "Piping Pointers" Bulletin No. 5.

"Piping Pointers" Free on Request

"Piping Pointers" Bulletins help you do three important wartime jobs: (1) Train new men for piping maintenance work; (2) Get better service from piping equipment; (3) Conserve critical metals. By using these Bulletins in maintenance shops and employee training classes, as many plants are doing, you share in Crane Co.'s *basic* information—gleaned from Crane's 87-year leadership in producing valves and fittings. Just ask your Crane Representative or write direct for your supply. No obligation!

Crane Co., 836 S. Michigan Ave., Chicago, Ill.

CRANE VALVES

Question No. 212

Why the Large CO_2 Difference?

Our 3-drum, bent tube, oil-fired boiler operates on natural draft and has one connection in the furnace and another connection between the last pass and the damper plate for taking orsat readings. The whole boiler is in excellent condition, even the smallest air leaks are carefully caulked. The stack temperature seldom rises above 460 deg. F. without economizer or preheater when operating at 120 per cent rating.

Orsat tests from the furnace as a rule show 13.5 to 14.2 per cent CO_2 while the stack gases just a foot ahead of the damper have only 9 to 9.5 per cent CO_2. Why this enormous difference? Could we, by any means get the same readings from the stack as from the furnace? Could this large difference in percentage of CO_2 be traced back to our steam atomizing oil burners? Can some reader help on this?

Brooklyn, N. Y. H. Ettelt

Question No. 213

Are His Heating Lines Filled with Scale?

I have recently taken charge of a heating system supplied by two 50-hp. boilers, operated one at a time and carrying 15 lb. pressure. The system is a low gravity return system. We use city water which has lime and iron in it, but we do not use any boiler compound or treatment of any other kind. The system is about 50 yr. old, but the boilers have been replaced and the ones now installed are almost new. What I want to know is whether the radiators and piping may be scaled up. We cannot heat the building like we did years ago and I have an idea that this is due to the fact that the lines have scale deposits in them. If they are scaled up what could I do to remove the scale?

London, O. Edward Smith, Jr.

Question No. 214

Color Code for Pipe Lines

It has been the practice in some power plants to paint the steam, air and water lines different colors. We have decided to paint our lines in this manner, but before doing so, we would like to find out if there is any combination for different lines, and if so, what the colors are.

Joliet, Ill. F. W. M.

This is a question that comes up quite frequently. About 10 yr. ago we presented an article outlining a standardized plan developed by a representative committee of industrial engineers. Since many seem to be interested in this question we are presenting the substance of the article referred to in the following paragraphs.

In this plan fluids are divided into 5 classes as shown in Fig. 1, with colors readily distinguishable and having already established association. In addition letter symbols are used as indicated in the accompanying tabulation.

Table 1. Classification of fluids with colors and symbols for identification

Class	Color	Letter Symbol
Fire Protection equipment	Red	F
Dangerous materials	Yellow Orange	D
Safe materials	Green White Black Gray Aluminum	S
Protective materials	Bright blue	P
Extra valuable materials	Deep purple	V

Red and fire departments have long been associated. Yellow and orange for danger are most readily distinguished of all colors and are used as a danger sign for quarantine and traffic signals. Green

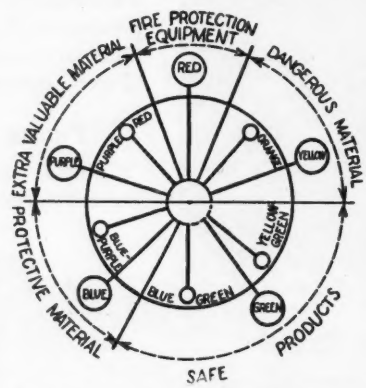


Fig. 1. The color circle is divided into five parts representing the five major divisions of the color code

is universally known as the safety color. Where desired, shades of these colors may be used for subdivisions of materials of various kinds.

Safe materials are in the majority, involve no hazard in handling, are not of extraordinary value and breaking into a line by workmen involves no serious hazard, even though the line is not drained.

Dangerous materials are hazardous to life and property because poisonous, easily inflammable or explosive.

Protective materials are those piped especially for overcoming or minimizing hazard such as antidotes to poisons or burns, generally to be released in case of danger.

Signs and Symbols

Instead of color shades for special materials it is sometimes of advantage to use a lettered name of the material carried and arrows to show the direction of flow as indicated in Fig. 2. Here visibility is important and signs should be so arranged, especially where pipe lines are grouped, that unobstructed view is obtained from some convenient point with good lighting. Lettering below the horizontal diameter of the pipe is less subject to obscuring by dust or mechanical damage. All legends should be clean and of a size to be easily read from considerable distance. For pipe under ¾ in. metal tags, painted or enameled may well be attached to the pipe. For larger sizes,

Table 2. Examples of various common fluids and their classification and color combination

Material	Classification	Color Stripes	Usual Temp. Deg. F.	Usual Press. psi
Brine	Safe—S	Green	0-20	60
Comp. Air	Safe—S	Gray	80	50-300
CO_2	Dang.—D	Orange	30-100	0-250
Ammonia	Dang.—D	Yellow—Purple	30-100	0-250
Gas	Dang.—D	Orange—Black	0-200	½- in. 250
Foamite	Fire—F	Red—Blue	0-60	100
Oils	Dang.—D	Orange—Purple	50-500	20-1200
Soda Ash	Safe—S	White—Blue	0-100	60
Steam				
Saturated	Dang.—D	White—Orange	100 & up	100 & up
Superheated	Dang.—D	Gray—Orange	300 & up	250 & up
Steam				
Saturated	Dang.—D	Yellow—White	200 & up	20 & up
Saturated	Dang.—D	Yellow—Green	100 & up	0-20
Vacuum	D	Yellow—Gray	50-150	
Water				
Fire Lines	Fire—F	Red		
Fresh	Safe—S	Green		
Circulating	Safe—S	Green—Blue		
Boiler Feed	Dang.—D	Green—Orange	100-200	100-400
Condensate	Safe—S	Green—Black	50-100	5-50
High Press.	Dang.—D	Green—Yellow		50-1000

STRETCH

YOUR PLANT'S STEAM CAPACITY

Are you racking your brain to figure safe ways of stretching the steam capacity of your present power plant equipment? There's a simple answer—safe, practical, effective: Hays Centralized Automatic Combustion Control, *"The All-Electric Way."*

These obvious benefits begin immediately when you install Hays Combustion Control:

- Automatic regulation of all combustion elements.
- Automatic measure of each variable—and instant automatic correction.
- Automatic *measure of each correction,* to maintain exact balance.
- Saves man hours—releases man power for other duties.
- Vital operating economies.

Hays Combustion Control is doing an outstanding job of increasing industry's steam capacity when that added capacity is most imperatively needed.

Hays Systems are individually designed to fit individual needs. Hays Combustion Control Catalog is full of useful data. Write for it.

THE MODERN SYSTEM *It's Electrical*

HAYS *Automatic* COMBUSTION CONTROL

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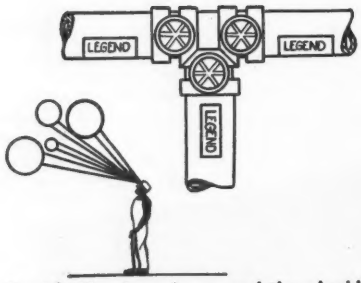


Fig. 2. When legends are used they should be carefully located

lettering sizes may be as follows:
Outside Diameter of lettered surfaces, in inches,
¾-1¼ 1½-2 2½-3 3½-4 4½-5 6-7 8-10 12
Height of letter, inches
½ ¾ ⅞ 1¼ 1½ 1¾ 3 3½

Care should be taken that the paints used will not deteriorate or change color by exposure to which they are subjected. For outdoor use, linseed oil is most durable, but, if extra resistance to water is required, china-wood-oil varnishes may be used.

Darker shades in browns, red and purples are less easily distinguished than bright shades; also greenish-blues and olive green are easily confused.

Examples of various common fluids and their classification and of color combinations to indicate special materials, are shown in Table 2.

Answer No. 183

More on Drying Air by Refrigeration

HERE IS some further information for A. A. E. in regard to his refrigerating system problem. In the June issue, p. 100, it may be recalled he asked for information which would enable him to lower the moisture content of the air from an air compressor in an oxygen liquefying plant. He had been using caustic potash for this purpose, but since he is located in Mexico and due to war conditions he can no longer get caustic potash. He, therefore had in mind lowering the temperature of the air by refrigeration to condense the moisture and, thus, save the caustic potash.

Several answers were received which were published on p. 101 of the October issue. Now, comes Walter Kalisty with more suggestions.

He Knows Whereof He Speaks

I was much interested in A. A. E.'s question because I have produced tons of liquid N_2 in my plant and think that I am qualified to say something about this subject that may be of value to others who have to produce cold liquids.

Suppose, A. A. E., when you put the initial charge of caustic solution in your wash tower, we assume it has a reading of Baume 13. Now if you subject this to a freeze test you will find that it sets at 22 deg. F. After you have run this solution for a number of hours, 100 or more, you will find that by test it is now Baume 17 with a lowered freezing point. What happened? Since A. A. E. does not give too much information in his question I will assume that his compressor is a 4-stage Norwalk or similar unit. Well, read on, but first let us run my own plant and maybe you will get an idea.

I produce liquid N_2, but to produce this N_2 I first must produce liquid O_2 with which to produce liquid N_2. We use the O_2 to condense out the N_2 gas. So we make up a charge of caustic potash flake 50 lb. to about 80 gal. of water, test to Baume 13 to 15, dump this to the wash tower. (You can use flake caustic or the lump, both will dissolve.) The wash tower does remove carbon dioxide. So you wonder where your level goes from the tower gage glass. By testing you find the solution has grown stronger, why? This loss goes into your compressor to your dryers and some into your column where you encounter trouble in the form of ice and snow. Moisture is contained in the air down to absolute zero and varies with temperature of the air by weight—through the process of compression in your compressor. You will find an emulsion of oil and water. This emulsion, if you run the compressor at high temperature, will find its way, some of it to your oil trap where it is blown out at regular periods, I hope.

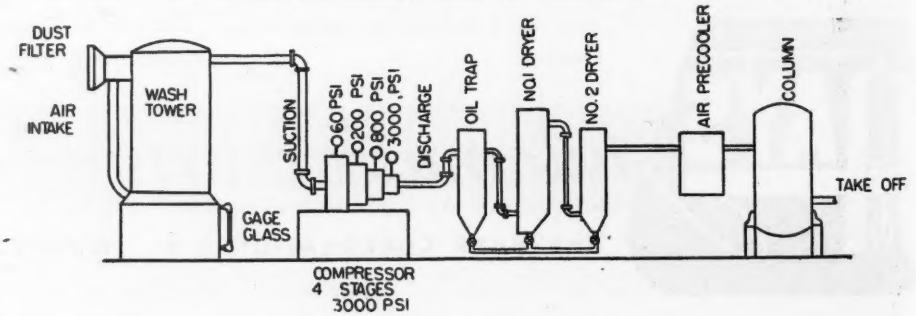
You want to freeze out the moisture left in the air before it enters the column: by the (Linde) method the air entering the column should be about —30 deg. C. or lower, so after the air under pressure goes through the oil trap and the dryers it should be cooled by a precooler between the dryers and the column using as a cooling medium either NH_3 or low temperature brine. The plant I have operated is like this—see diagram.

The air precooler is a special built cooler and can be purchased from the Superior Air Products Co.

You may add water to the caustic solution and dilute it back to the original strength. But in oil cases, use your head because the solution can be too dirty and should be thrown out. You should not have any troble in obtaining caustic for your tower, since people who produce liquid O_2 today must be producing towards the war effort.[1]

Modena, N. Y. WALTER S. KALISTY

[1]Mr. Kalisty did not know that A. A. E.'s plant was located in Mexico.



Liquid Air System Used by Mr. Kalisty

Answer 190

Ammonia Mixture and Fire Line Connection

IT MAY be recalled, on p. 98 of the September issue, J.K. of New York City asked about the proper hook-up of ammonia mixture and fire department Siamese connections. It seemed that there was no standard practice in this respect and he wondered what other readers could tell him about practice in their plants.

Two replies to this question are presented here, one from our friend Martin Gozdenovich and the other from E. Dingfelder of Woodside, Long Island.

Cites A.S.R.E. Recommendations

The American Society of Refrigerating Engineers recommends that all refrigerating plants of 3 tons refrigerating capacity or over using ammonia or ethyl chloride as a refrigerating agent shall be equipped with a device or devices for discharging the refrigerating agent under pressure, in case of emergency, into sufficient water to absorb all discharge gas and carry it off to the sewer.

No valves should be located in the discharge lines excepting the control and check valves to the water and refrigerating mixer, but there may be one control valve on each emergency line located near connections to main high and low-pressure lines for repair purposes only. These additional valves must be kept open at all times.

The standard fire department Siamese connections and the emergency valves should be located on the public thoroughfare-side of the building, either located outside of the building or in a vestibule having glass panel doors which should provide easy access from the street, and valves located not more than 5 ft. above the street or floor level.

Care must be taken that the emergency valves are not located over the exhaust outlet for ventilating the room containing the refrigerating plant.

Large refrigerating plants have gages installed on the high and low emergency or for the determining of changes in pressure while emergency lines are operating.

Emergency valves must be protected with a box and kept locked. The lock shall be opened by a fire department inner

How to Make an Old COPES Valve Like New in Sixty Minutes

UNCLE SAM wants to keep COPES equipment in active service as long as possible and so do we. With more than 60,000 of these COPES Valves in service, you can make a real contribution to the war effort by "keeping them regulating at top efficiency." Lucky for you and for us it is a simple routine job. The only moving part in the valve, lifts out with the removal of four studs. The two seats come out with a simple tool. By replacing as a matched set the plunger cylinder and the new seats, the valve is like new again.

ATTENTION 60,000 COPES USERS!

▶ COPES' Users, let's get together to keep these 60,000 boiler water level guardians in fighting trim. Their simple, sturdy design makes it easy and economical. Write for recommendations modernizing your COPES Feed Water System.

NORTHERN EQUIPMENT COMPANY • 132 GROVE DRIVE, ERIE, PA.

Feed Water Regulators • Pump Governors • Differential Valves • Liquid Level Controls • Reducing Valves and Desuperheaters

BRANCH PLANTS IN CANADA, ENGLAND — REPRESENTATIVES EVERYWHERE

OVER 60,000 COPES FEED WATER REGULATORS IN SERVICE

COPES — FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

★ GET CLOSER LEVEL CONTROL WITH THE FLOWMATIC ★ REGULATOR

box key and only by members of the fire department.

The box should have printed on it: For Fire Department Use Only. The high-pressure valve shall be labeled: High-Pressure Ammonia. Low-pressure valves should be labeled: Low-Pressure Ammonia.

If ethyl chloride is used the words Ethyl Chloride are lettered. The other sign on the box should be printed: DO NOT OPEN VALVES UNTIL WATER IS FLOWING.

Several reasons influence the design of a plant. Most of the time it is the limited amount of space allotted to the designing engineer; in other cases to save face, designing engineers or architects have hurriedly installed connections, that to the experienced refrigerating engineer, the type of connections installed would certainly cause the refrigerating engineer to turn blue in the face with anger.

Whenever a job is too expensive to install, there will always be someone who will try to do a job just so long as it will pass inspection; let the operating crew worry about the monuments the designing engineers have put up for themselves.

Fairview, N. J. MARTIN N. GOZDENOVICH

Diagram for Ammonia Compression Systems

ACCORDING to the city (N. Y.?) code of the fire department the proper hook-up is as shown by the accompanying diagram. This diagram is for a class A ammonia compression system. As indicated the relief or safety valve discharge

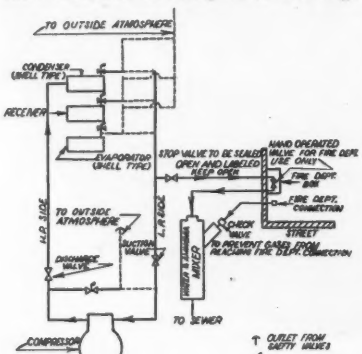


Diagram for ammonia compression systems submitted by Mr. Dingfelder

is to be connected to the outside atmosphere above the roof or not less than 12 ft. above the grade or into that part of the low-pressure side protected by the mixer.

Woodside, L. I., N.Y. E. DINGFELDER

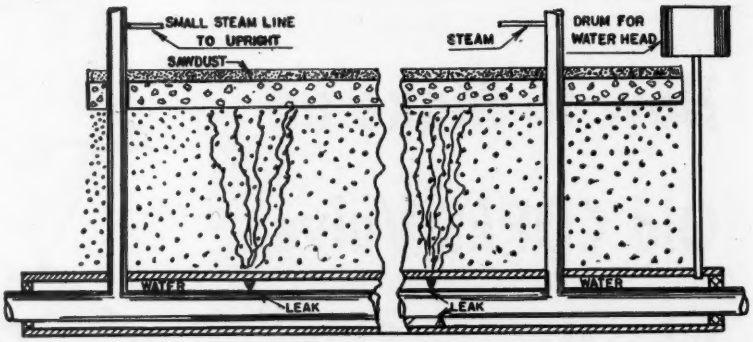
Answer No. 193

Locating Leaks in Buried Vacuum Lines

HERE IS a rather ingenious, and probably quite effective way for I.D. to find the leaks in his buried vacuum line. As described on p. 96 of the October issue this line, buried 2 to 3 ft. below a 5-in. concrete floor had developed a number of leaks. I.D.'s problem was to locate these leaks without having to tear up 200 ft. of concrete floor.

The Temperature Rise of Sawdust Method

The writer of this question is willing, no doubt, to try almost anything within reason when faced with the possibility of having to tear up 200 ft. of cement floor.



Locating leaks in underground piping by temperature rise of sawdust on the floor above

To get a fairly accurate idea of the location of these leaks I suggest he try the arrangement shown in the accompanying sketch.

Assuming that the ends of the tile pipe can be conveniently reached have them sealed with cement or other suitable material around the enclosed vacuum line. Tap into the tile and lead a pipe up to the floor as shown and fill the tile pipe with water. Have a drum filled with water to keep a head on the line while testing.

Lay a layer of wet sawdust about 4 in. deep along the floor of the entire length of the pipe. Hook a steam line in by way of the uprights above the floor where convenient and allow the steam to flow into the line for a period long enough to show by temperature rise on the sawdust where the leaks occur.

A thermometer inserted in the sawdust at various points should give accurate accounts of the leaky points.

This arrangement will no doubt take a number of hours to function, but I believe could be conveniently done over the week-end and allowed to run for say, 24 hr. at least.

This may seem a crude idea, but it is at least inexpensive and is surely worth trying rather than digging up the floor by hit and miss.

Kearny, N. J. GEORGE MCNALLY

Answer 198

A Trap Question for the Trap Experts

THIS concerns the experience recounted on p. 101 of the November issue by F.W.B. Fitters had worked on a certain trap all day and completed the job just in time to catch a train. Then when the superintendent of the plant turned on the steam the trap failed to work. Mr. Holman who submits the comment below thinks maybe this question is a trap for the trap experts and he may be right.

He Thinks it is a Trap

ON 'a-question for trap experts,' I am inclined to believe that this is a catch question. Since the likelihood of the fitters bringing along the wrong trap is so small, I would say that the blue tag is a false clew or irrelevant, and that a hint leading to a solution is to be found in the sentence: 'The superintendent of the plant turned on the steam and found to his disappointment that the trap failed to work.'

Since this was a large dye house, there were in all liklihood several traps discharging into the same return line. At least one more would have to be on the line, unless production were held up while this one was installed. Whenever a trap is opened or removed for cleaning or repair, it is necessary in many multiple installations to have a valve in the branch of the return leading to it. Otherwise steam and hot water from the other traps will kick back into the room.

No mention of this valve is made, of course. And since it had to be closed while the fitters did their work, the turning on of the steam by the superintendent was ineffective in starting the trap.

Doubtless the engineer did not at first think of the return valve himself, and first looked the trap over thoroughly in an effort to find the reason why it did not work.

This is probably the reason why, now that he is an examiner, he wants to stress the point that engineers should look for a valve in places like this——the old technique of the golfer or baseball player in 'Following through.'

GEORGE HOLMAN

He Had the Same Trouble

"WHEN we were faced by the same problem some time ago, the manufacturer of the trap as well as the inspector stated that the trap body was built for a safety factor of 3, and that there was no objection to raising the operating pressure from 90 lb., for which the trap was built, to 120 lb.

"When the trap with the higher pressure did not work, we replaced the 1-in. renewable, single seat and disk of the trap valve by a ¾-in. seat and disk, supplied by the trap manufacturer to fit into the same valve. Ever since, the trap works like a clock without any trouble.

"Perhaps we got the same results, if we had added dead weight to the trap body to overcome the higher total of pressure per square inch times the area of the valve opening times the length of the lever arm. However this had resulted in greater friction on the fulcrum.

"Possibly your examiner changed the proportional lengths of the short and long lever arms, or he had a pressure reducer installed ahead of the trap."

Brooklyn, N. Y. HUBERT ETTELT

AN IMPORTANT ANNOUNCEMENT TO ALL TUBE CLEANER BUYERS

Because it has become impossible for us to meet the ever increasing demand for Wilson Tube Cleaners and Wilson tube cleaning accessories in our plant at 47-28 37th Street, Long Island City, N. Y., we have purchased the building shown in the above photograph.

In our new home we will have available over three and one half times the floor space we had in our former plant. We have installed many new high speed machine tools and the greatly increased production capacity which these additional machines are giving us enable us to make more Wilson Tube Cleaners and accessories and also to make quicker shipments.

Write for the name of our representative nearest to you or ask for a copy of our NEW forty-page catalog which fully describes and illustrates the complete line of Wilson tube cleaning equipment.

INVEST IN AMERICA! BUY WAR BONDS AND STAMPS!

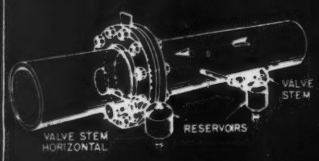
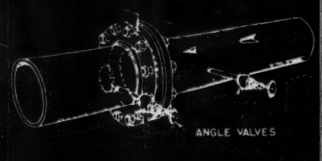
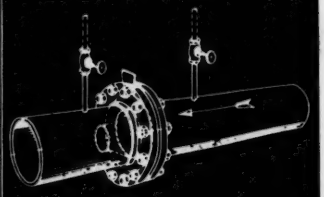
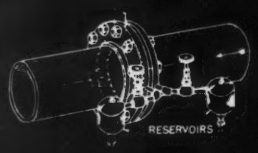
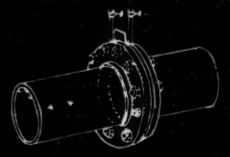
THOMAS C. WILSON, Inc.

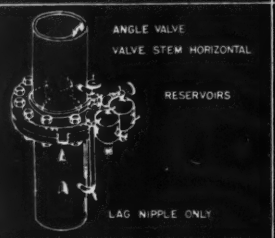
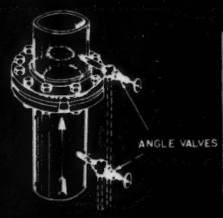
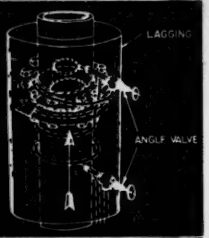
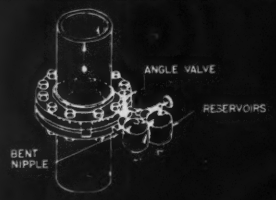
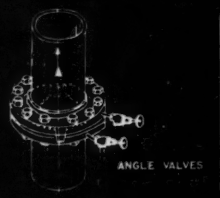
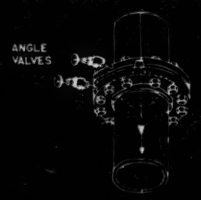
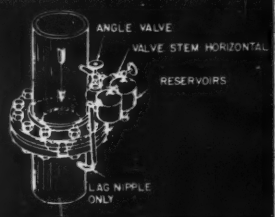
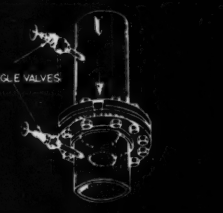
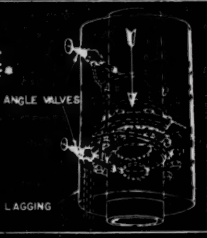
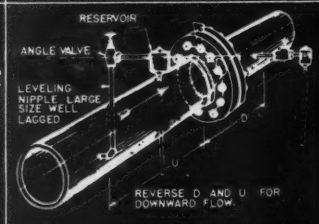
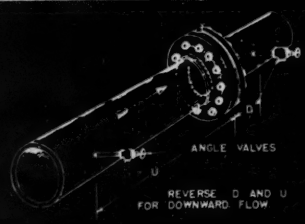
PIPE AND TUBE CLEANERS EXCLUSIVELY

THE WILSON BUILDING

21-11 44TH AVE. LONG ISLAND CITY, N. Y.

INSTALLING THE PRIMARY FLOW METER ELEMENT

	STEAM	LIQUIDS *	AIR OR GAS
FLOW HORIZONTAL — PIPE TAPS			
FLOW HORIZONTAL — FLANGE TAPS			

	STEAM	LIQUIDS, AIR OR GAS
FLOW VERTICAL UPWARD — PIPE TAPS		TEMP. 250°F AND BELOW*  TEMP. ABOVE 250°F* DOWNSTREAM LEAD TO METER WOUND CLOSE TO PIPE TO EQUALIZE TEMP. 
FLOW VERTICAL UPWARD OR DOWNWARD — FLANGE TAPS		 
FLOW VERTICAL DOWNWARD — PIPE TAPS		TEMP. 250°F AND BELOW*  TEMP. ABOVE 250°F* 
FLOW INCLINED UPWARD OR DOWNWARD — PIPE TAPS		

THIS FULL PAGE OF DETAILED DRAWINGS WAS PREPARED AS FIG. 1 OF THE ARTICLE THE WHY, WHEN, WHERE AND HOW OF FLOW METER INSTALLATION BY W. C. BENNETT WHICH APPEARS EARLIER IN THE PRACTICAL ENGINEER & ELECTRICIAN SECTION OF THIS ISSUE.

TUBING MUST SLOPE TOWARD METER AT LEAST ONE INCH PER FOOT

RESERVOIRS MUST BE EXACTLY LEVELED — * ALWAYS USE RESERVOIR WHEN METERING HOT WATER ABOVE 250°F

SOLNUS OILS

End Carbon Trouble . . . Stop Ring Sticking

Black-outs weren't always scheduled by the Army interceptor command in a certain Eastern town before they switched to Solnus Oils.

What did a change in lubricants have to do with black-outs? Just this! All of the town's power and light were supplied by two large Fairbanks-Morse diesel driven generators . . . and a breakdown of the diesels could mean lights out for everyone. And breakdowns did occur! But they were due entirely to faulty lubrication. Carbon built up . . . rings stuck . . . and operating temperatures soared. The engines became noisy . . . cylinder walls scored.

The advice of a Sun Lubrication Engineer soon put a stop to any breakdowns. This Doctor of Industry simply recommended a change from competitive oils to Solnus Heavy Oil. Since then these engines have been running quieter and cooler. Shutdowns have been reduced 66% . . . trouble with carbon and ring sticking stopped . . . and there hasn't been a sign of additional cylinder scoring.

This is another example, taken from the many in Sun Oil records, of how Sun's Doctors of Industry have proved themselves trouble-shooters for industry's lubrication problems. Whatever your problem, involving any petroleum product, call in a Sun Oil Engineer. His services are yours to use to help speed victory with more production. Write . . .

SUN OIL COMPANY • *Philadelphia*

Sun Oil Company, Ltd., Canada

SUNOCO

SUN PETROLEUM PRODUCTS *HELPING INDUSTRY HELP AMERICA*

War News From the Industrial Front

WPB's New "Controlled Materials Plan"

THE Controlled Materials Plan recently inaugurated by the War Production Board has become the new way of life for the majority of the manufacturers of the United States.

The "plan" outlines the technical details of the CMP and the steps that should be taken by industry and the governmental agencies handling materials and production programs and schedules.

Following is a brief resume of the plan. The complete plan may be had by addressing the Office of War Information, War Production Board, Washington, D. C.

Major Points of the Plan

The sketch below clearly illustrates how the supply of steel, copper and aluminum is forced into balance with the demand by the following method:

1. The producers of these metals will report the available supply and rate of output for the coming quarter to the Controlled Materials Divisions.

2. The secondary consumer at the bottom of the ladder will send Bills of Materials covering his requirements, to produce his product, to his Prime Consumer.

3. The Prime Consumer will gather all of these Bills of Materials together with his own, to complete his finished product, and will send a total summary to the Claimant Agency, (Example The Maritime Commission).

4. The Claimant Agency will then multiply these requirements by the contemplated program and will send the grand total to the Requirements Committee.

5. The Requirements Committee will adjust the demand with the available supply, and issue the allotments.

6. The Claimant Agency will receive the adjusted allotments and pass them on to the Prime Consumer in the form of adjusted approved schedules.

7. The Prime Consumer will divide his allotments with his various secondary Consumers.

8. Orders are then placed with the mills bearing allotment numbers, which will assure delivery of that material in the approved period.

How to Save Fuel at Home

HOW TO SAVE FUEL AT HOME, a new circular compiled by the Bureau of Mines, offers advice on how to save coal in household heating. Copies may be obtained free of charge by writing to the Bureau of Mines, Department of the Interior, Washington, D. C.

Enough Coal on Hand to Replace Oil

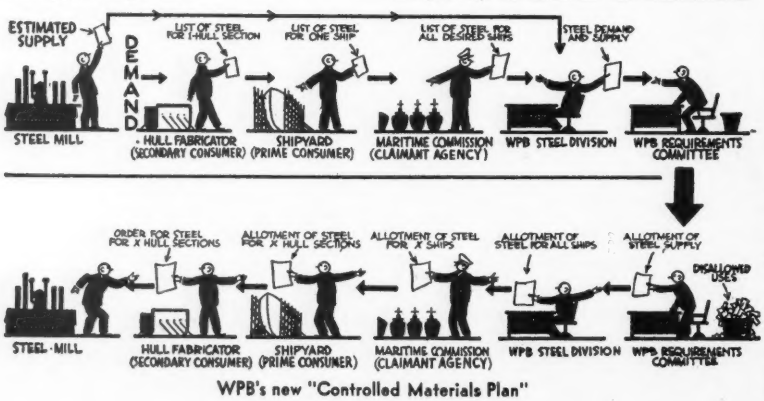
THE COAL industry, if given adequate equipment, transportation, and manpower, can supply the 15,340,000 tons of coal that would be needed annually to replace fuel oil in the East and Middlewest under present conversion goals, in addition to meeting the war-expanded requirements of regular coal users, Solid Fuels Coordinator for War Ickes said December 2.

Mr. Ickes said that domestic and industrial consumers who can convert from oil to coal should not hesitate to do so for fear of an inadequate coal supply. In general, the present coal supply is sufficient for current consumption requirements, although many users still need additional heavy tonnages to increase their storage piles to safe wartime margins.

Coal Users to Pay Tax

CONSUMERS of all grades of coal and other solid fuels will pay the 4 ct. per net ton transportation tax imposed by the Revenue act of 1942 effective December 1, OPA announced December 5. Under the OPA ruling the tax may be passed on to the ultimate consumer, but must be stated separately from the price the consumer pays for the coal and may not be included in the computation of maximum prices, nor be charged except on coal on which the tax has actually been incurred.

For the purpose of collection of the tax, the Bureau of Internal Revenue has ruled that the term "coal" includes bituminous, anthracite, lignite, coke, and several other miscellaneous solid fuels. In the process of issuance are amendments to all Office of Price Administration maximum price regulations governing the sale of coal and other solid fuels, pertaining to the addition and collection of the tax. The amendments are retroactive to December 1.


ESTIMATED SUPPLY
DEMAND
LIST OF STEEL FOR 1 HULL SECTION
LIST OF STEEL FOR ONE SHIP
LIST OF STEEL FOR ALL DESIRED SHIPS
STEEL DEMAND AND SUPPLY
STEEL MILL
HULL FABRICATOR (SECONDARY CONSUMER)
SHIPYARD (PRIME CONSUMER)
MARITIME COMMISSION (CLAIMANT AGENCY)
WPB STEEL DIVISION
WPB REQUIREMENTS COMMITTEE
ORDER FOR STEEL FOR X HULL SECTIONS
ALLOTMENT OF STEEL FOR X HULL SECTIONS
ALLOTMENT OF STEEL FOR X SHIPS
ALLOTMENT OF STEEL FOR ALL SHIPS
ALLOTMENT OF STEEL SUPPLY
DISALLOWED USES
STEEL MILL
HULL FABRICATOR (SECONDARY CONSUMER)
SHIPYARD (PRIME CONSUMER)
MARITIME COMMISSION (CLAIMANT AGENCY)
WPB STEEL DIVISION
WPB REQUIREMENTS COMMITTEE

WPB's new "Controlled Materials Plan"

Oil Operators Can Now Sell Material Stocks

SALE of heretofore frozen stocks of materials in the oil industry is now permitted by WPB Preference Rating Order P-98-c, which was issued December 1 upon the recommendation of the Office of Petroleum Coordinator for War. The new order permits the sale of inventory stocks by one oil operator to another oil operator.

All reports required to be filed and all communications concerning P-98-c should be addressed to "Office of Petroleum Coordinator for War, South Interior Building, Washington, D. C., Ref.: P-98-c," or "Office of Oil Controller, Dominion of Canada, Toronto, Canada. Ref.: P-98-c."

Coke Export Prohibited Without WPB Authorization

TO PREVENT the use of American petroleum coke, important in the aluminum program, for nonessential purposes in foreign countries, the WPB has prohibited the export of the coke without its written authorization.

This step was taken by issuance of an amended version of Conservation Order M-212, effective November 21. Persons seeking authorization to make export deliveries must inform the Aluminum-Magnesium Division by letter of all details of the proposed export, including the use to which the petroleum coke is to be put.

Rent Ceilings Set on Construction Pumps

DOLLARS and cents maximum rental rates for major types of pumps used in construction and road maintenance work were announced November 23, by the OPA.

Inadvertently, they were left out of the list of items for which dollars and cents ceiling rental rates were posted October 22 in Amendment No. 3 to Maximum Price Regulation No. 134 (Construction and Road Maintenance Equipment Rental Prices and Operating or Maintenance Service Charges).

The pump ceiling rentals now are embodied in Maximum Price Regulation No. 134 through Amendment No. 5, effective retroactively to October 22.

Indiana Ordnance Plant Expansion Stopped

ACTING under the policy of curtailing the use of materials for construction projects, the WPB on November 28 ordered immediate stoppage of all work incidental to the construction and equipment of the $45,000,000 expansion for the Continental Ordnance Plant at Hammond, Ind.

All construction programs, under the WPB policy, must balance with production programs and the proposed expansion at Hammond would not be completed in sufficient time to justify the large expenditure of critical materials.

NO. 1 OF A SERIES

HOW TUBE-TURN WELDING FITTINGS BENEFIT WAR INDUSTRY

The FIRST WELDING FITTINGS 1ST AND STILL THE BEST

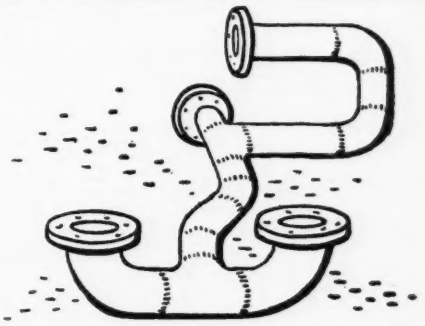
How Tube-Turn welding fittings speed-up piping installation for war production!

SIER, FASTER, SAFER WELDING

e-Turn fittings require only easy circumfer-
al butt welds—which insure faster, better, safer
ding by both veteran and novice operators.

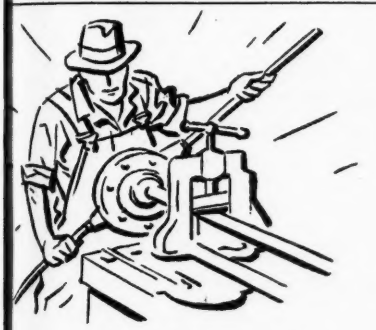
ALIGNING TIME GREATLY REDUCED

Tube-Turn fittings simplify lining-up operations —because their uniform wall thickness and true circularity permit quick alignment with pipe.



WHOLE SECTIONS CAN BE PRE-ASSEMBLED

As Tube-Turn fittings and welded joints stand strain and save weight, piping sections can be welded on the ground to save time, then erected.

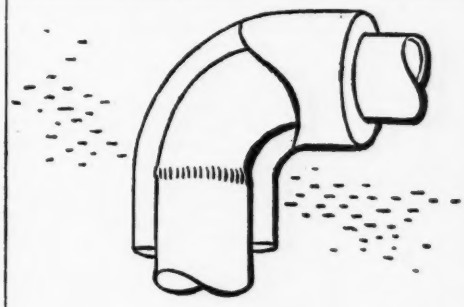


NO THREADS TO CUT

ding removes the inefficiencies of threaded
s, plus the labor and time applied to thread-
Tube-Turn fittings come ready to install.

NO TORCH CUTTING OR FABRICATION

Since all Tube-Turn fittings are installed with easy-to-make butt welds, they eliminate time-consuming, complicated cutting and fabricating.



FASTER AND EASIER TO INSULATE

Tube-Turn fittings are insulated as readily as the pipe, for the welds form one continuous tube. Eliminating many flanged joints shortens covering time.

VER FLANGED JOINTS SPEED ERECTION

ding fittings supplant the need for many of
flanged joints necessary in screwed piping,
h materially reduces over-all erection time.

FEWER HANGERS OR SUPPORTS NEEDED

As welded piping weighs less and stands vibration better than flanged systems, the fewer hangers needed save installation time on these items.

. . And you get stronger, leakproof systems that virtually eliminate piping maintenance or failures that can slow down or paralyze vital war industry!

TUBE TURNS
INCORPORATED

Branch Offices: New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Tulsa, Houston, Los Angeles. *Distributors everywhere.*

UBE-TURN *Welding Fittings*
TRADE MARK

ARMY E NAVY

Copper, Nickel, Chrome, Tin Banned for Feedwater Heaters

THE USE of copper, copper base alloys, or alloys containing nickel, chrome or tin in tubing or tube sheets for feedwater heaters is prohibited in Schedule III to Limitation Order L-154, issued November 21. Seamless steel tubing is also prohibited. Excepted from the order are materials needed for the repair of an actual breakdown which involves the replacement of not more than 25 per cent of the tubing in a feedwater heater.

Production for Synthetic Rubber Plants

PRODUCTION of several million dollars' worth of electric apparatus for synthetic rubber plants is now being rushed at every major General Electric plant.

According to General Electric, many plants are beyond the design stage and the company is speeding production on orders for apparatus which will supply power in plants now under construction in various parts of the country for the conversion of petroleum and alcohol derivatives into synthetic rubber.

What are probably the largest turbine-generators ever designed for chemical process plants are included in the list of equipment on order. Other apparatus, transformers, switching equipment, and motors are being manufactured on a mass production basis to perform major functions in the processing of butadiene and styrene and in polymerizing or mixing them into buna rubber.

The large turbine-generators have been adapted from similar apparatus which has long been supplied to public utilities. At a plant under construction in Texas, General Electric will furnish a turbine-generator rated at 35,000 kw. The company will also provide two 25,000 kw. turbine-generators for a completely electrified refinery devoted to synthetic rubber, aviation gasoline, toluene, and other war products in Louisiana.

Other electric equipment being made available for synthetic rubber plants ranges all the way from Diesel-electric locomotives to small, but powerful, floodlights and searchlights. The locomotives are designed for switching tank cars in which rubber ingredients are shipped from one plant to another, while the lights, focused on plant boundary fences, provide for protection against sabotage.

Turbine Production Doubled

PRODUCTION of propulsion equipment for naval vessels and turbines for land power houses at the Westinghouse Steam Division, South Philadelphia, Pa., has more than doubled in the last ten months as compared with the ten months preceding Pearl Harbor, according to A. W. Robertson, Chairman of the Board of Directors of the Westinghouse Elec. & Mfg. Co. In the ten months before Pearl Harbor, deliveries amounted to $23,998,000 and in the ten months since Pearl Harbor deliveries have totalled $50,356,000, an increase of 109 per cent, and the total for the year is expected to be nearly $70,000,000 worth of delivered equipment.

Factors contributing to the Steam Division's record production were a 29 per cent increase in employment, a $13,000,000,000 expansion program and the help of more than 50 other manufacturers who are building equipment for the Division on sub-contracts which total nearly $20,000,000. The Division in concentrating on the production of turbines and gears for naval vessels of many types, propulsion equipment for war-cargo ships and powerhouse turbines for the generation of war-needed electricity.

During this same period, Mr. Robertson also announced that the $26,000,000 Merchant Marine Division Plant has been built, equipped, and will soon deliver, at least four months ahead of schedule, its first complete ship propulsion unit, consisting of high pressure turbine, low pressure turbine and driving gears.

Industrial Equipment Maintenance

THE WPB issued an interpretation to make clear that the exemption from distribution control of general industrial equipment for certain repair and maintenance purposes does not apply to spare parts for new equipment. Equipment is considered "new" when it has not been delivered to a person acquiring it for use. The interpretation states "the exemption is intended to provide for the repair and maintenance of any existing equipment which has been delivered for use including equipment delivered prior to the issuance of the order."

Oil to East to Increase

IN ORDER to meet civilian needs and growing military requirements for petroleum and petroleum products, ODT Director Eastman set as the "minimum goal" the daily delivery to the East of 900,000 bbls. as against the current volume of approximately 750,000 bbls.

South America Benefits by U. S. Metal Demand

TREMENDOUS war demand for metals in the United States has offset loss of markets outside the hemisphere for copper, lead, nitrates and similar materials. Mexico and the West Coast countries—Peru, Bolivia, Chile—benefit mainly by the demand for metals.

For the longer range, the Americas to the south have the prospect of important new industries by producing materials now in demand, such as rubber, fibers and metals.

Electric Furnace Carbon Steel Controlled

CARBON STEEL made in electric furnaces has been placed under controls because of the shortage of electric furnace capacity. Producers of alloy iron and alloy steel and producers of electric furnace carbon steel now must submit their melting and delivery schedules to WPB for approval. Producers may not melt or deliver alloy iron, alloy steel, or electric furnace steel before such approval is granted by WPB.

Tank Trailers to Relieve East's Oil Shortage

THE MANUFACTURE of 300 semi-trailer petroleum tanks to help relieve the oil shortage in eastern states is provided for in Supplementary Limitation Order L-1-G as amended December 10 by WPB.

Each semitrailer to be manufactured will hold about 4000 gal. and transport more oil per pound of steel and rubber and require less manpower than any other type of vehicle available for general use.

Hydroelectric Power Increases

HYDROELECTRIC power has gained more than 400,000 kw. (43 per cent) or enough to take care of a city of a million people, according to the annual report, December 14, of the Commissioner of Reclamation, John C. Page. Large gains were also cited in water storage capacity and in food production. The storage capacity of reservoirs on reclamation projects rose 29 per cent owing to completion of new dams, and crop values on lands supplied with irrigation water by reclamation works during the 1941 growing season jumped 35 per cent.

The year's gain in hydro power raised the total installed capacity in 28 electric plants on 17 reclamation projects in 11 Western States to nearly 1½ million kilowatts. Three big new generators were installed in the Grand Coulee Dam power plant on the Columbia River in Washington; increasing total capacity to more than a third of a million kilowatts. At Boulder Dam in Arizona-Nevada on the Colorado River another big generator was installed, raising the total number of generators in operation to 10, the largest array of hydro power ever synchronized into action under one roof, with a total capacity of more than three-quarters of a million kilowatts.

New generators will soon be added at Boulder, Parker (on the Colorado River below Boulder), and Grand Coulee Dams which will add another 400,000 kw. within 8 mo., raising the total capacity of power plants on reclamation projects to nearly 2 million kilowatts. By May, 1944, capacity is expected to reach nearly 2½ million kilowatts.

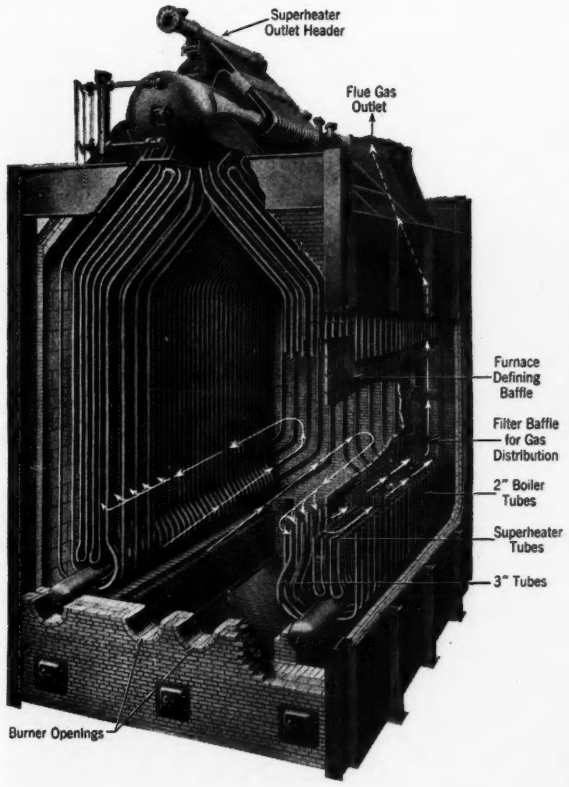
New Uses for Tin and Terneplate

SEVERAL new uses for tin plate and terneplate will be permitted under Conservation Order M-21-e as amended December 11 by the WPB.

The new permitted uses are: Component parts for internal combustion engines including cooling, fuel, and lubricating systems—(but only where the need for corrosion-resistant or solderable parts makes the use of less essential material impractical) electrical equipment parts requiring solderable coatings; gas mask canisters; safety cans for inflammable liquids; vaporizing liquid fire extinguishers; wick holders for oil stoves (replacement only); and heat exchangers.

50 more "S-A" BOILERS for INDUSTRY

Fifty "S-A" power plant boilers are now under construction . . . evidence of their unusual fitness for war's most urgent power requirement—"maximum steam from minimum materials".



Characteristics of units on these various orders include:—

Capacities	— from 15,000 to 200,000 lb. of steam per hour
Pressures	— to 650 lb. per square inch
Final Steam Temperatures	— to 740° F.
Fuels	— Pulverized Coal Oil Refinery Gas Oil or Gas Also dual firing of gas and coal

The Army-Navy Production "E" has been awarded to Foster Wheeler in recognition of quality equipment, in quantity, on time.

FOSTER WHEELER CORPORATION, 165 Broadway, New York, N. Y.

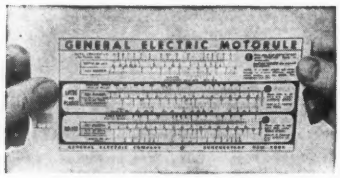
FOSTER WHEELER

New Equipment

Information that you desire about any equipment will be gladly furnished without obligation. WRITE POWER PLANT ENGINEERING.

Motorule

GENERAL ELECTRIC Co., Schenectady, N. Y., is offering free of charge a newly developed load calculator, known as the Motorule, which simplifies computing motor horsepower required for metal cutting operations on various machine tools. This device is expected to be of assistance in helping industrial concerns make sure that machines being put to new war work have proper motor capacity. It is said to be of help also in selecting motors for machines formerly driven from line shafting.



The motorule is designed along the lines of an engineer's slide rule and is accurate for a wide variety of cutting operations on lathes, drills, planers, and milling machines. Operation is simple. The user first refers to a convenient table of constants on the back of the rule, choosing the constant for the particular type of metal to be cut. Then by setting the scales to the known cutting speed, feed, and cut, the user arrives at the cutting power required on the basis of ideal tool and machine conditions. Complete operating instructions are furnished with each Motorule.

Generator Voltage Regulator

THE Burlington Instrument Corp., Burlington, Iowa, has recently announced a new generator voltage regulator, the Type GL-1, applicable to individual small

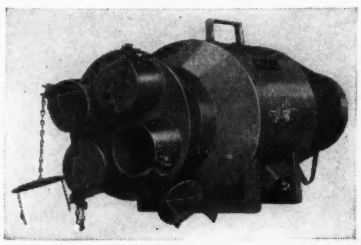
alternating current generating plants having separate exciters and for controlling individual generating units operating in parallel with other generating units by using automatic cross current compensation. It is suited for portable generating sets and is said to meet radio interference and regulation requirements of the Signal Corps and Radar.

The regulator is suitable for the control of single, 2 or 3-phase alternators and is normally furnished for 50-60 cycle operation with 25 cycle type furnished on special application. It is available for 110-120 v. or for 208-240 v. Higher voltages require potential transformers.

This unit is simply constructed, provides smooth and close regulation and weighs 10 lb. It is 9 in. high, 6½ in. wide and 4½ in. deep.

Portable Blower and Exhauster

FOR ELIMINATING gases, fumes, etc., from closed-in places, such as shipholds, welding rooms, tunnels, vaults and basements, the Chelsea Fan & Blower Co., Inc., Irvington N. J., announces the Octopus Jr., a small, but powerful, portable exhauster and blower.



This unit weighs 70 lb. and operates in any position. It is powered by a ¾-hp. ball bearing motor and has a capacity of 2000 c.f.m. Adapters for three 4-in. nozzles or four 3-in. nozzles for flexible hose are provided with caps to close nozzles that are not in use. Each 4-in. metal hose of 20-ft. lengths will exhaust 250 c.f.m., and each 3-in. hose over 200 c.f.m. The entire unit can be hung in a small manhole.

Coal Scales

TWO NEW double feeder automatic coal scales, both of the same general principle but of different feeder lengths, have recently been announced by the Richardson Scale Co., Clifton, N. J.

These scales are of all-welded construction with all operating mechanism on the outside of the dust-proof casing. The operating parts, such as weigh beam, switches, levers and controls are protected against dust and accidental damage by a metal outer housing and easily removable or quick opening access doors are provided for inspection or access to parts. No electrical equipment is carried inside of the dust-proof casing.

Figure 1 shows a scale of 16 ft. centers with three separate inlet openings or bunker connections. At one end is the shorter conveyor of 4 ft. centers which receives coal from one bunker opening and delivers the coal to the weighing hopper. At the other end is the 12 ft. center feeder which takes coal

Fig. 1

from two bunker openings and delivers to the same weighing hopper. A special unified drive makes it possible for either conveyor to be operated as required and operation of either feeder is controlled electrically by mercury switches actuated by the movement of the single lever weigh beam. Each discharge of weighed coal from the weighing hopper is recorded and totalized on a six-figure continuous counter of rust-proof and dust-proof construction.

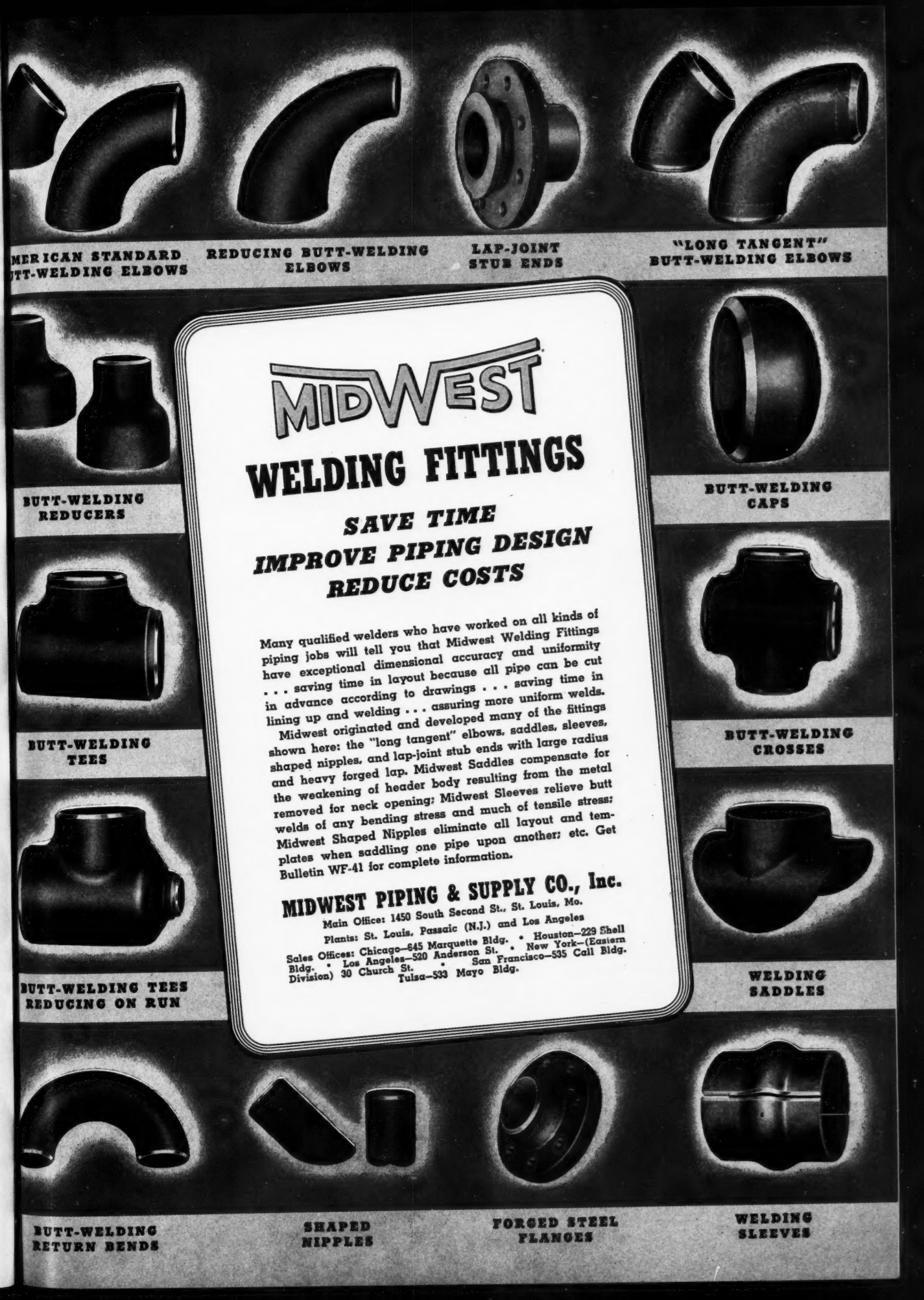
Fig. 2

Figure 2 shows a similar scale of 35 ft. centers which takes coal from five separate bunker openings, two on one feeder and three on the other. Either feeder may be operated at will.

These scales are supplied with a built-in bypass so that in event of emergency coal may be passed direct from bunker to stoker or pulverizer without weighing and without removing the belt feeder.

Masonite as Steel Substitute

IN LINE with conserving sheet steel so vitally needed in our war effort, The Hays Corp., Michigan City, Ind., announces instrument and control panels made of Masonite reinforced with steel angles. The body of the panel is made of cross grained Masonite 5/8 in. thick, bolted to a framework of 3 by 3 angle steel. Braces of 2 by 2 angle steel reinforce the center of the panel to insure adequate support for the instruments and controllers. The canopy and doors are of cross-grained Masonite ⅛ in. thick.



MIDWEST

WELDING FITTINGS

SAVE TIME
IMPROVE PIPING DESIGN
REDUCE COSTS

Many qualified welders who have worked on all kinds of piping jobs will tell you that Midwest Welding Fittings have exceptional dimensional accuracy and uniformity . . . saving time in layout because all pipe can be cut in advance according to drawings . . . saving time in lining up and welding . . . assuring more uniform welds.

Midwest originated and developed many of the fittings shown here: the "long tangent" elbows, saddles, sleeves, shaped nipples, and lap-joint stub ends with large radius and heavy forged lap. Midwest Saddles compensate for the weakening of header body resulting from the metal removed for neck opening; Midwest Sleeves relieve butt welds of any bending stress and much of tensile stress; Midwest Shaped Nipples eliminate all layout and templates when saddling one pipe upon another; etc. Get Bulletin WF-41 for complete information.

MIDWEST PIPING & SUPPLY CO., Inc.

Main Office: 1450 South Second St., St. Louis, Mo.

Plants: St. Louis, Passaic (N.J.) and Los Angeles

Sales Offices: Chicago—645 Marquette Bldg. • Houston—229 Shell Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. • San Francisco—535 Call Bldg. Tulsa—533 Mayo Bldg.

Masonite material is exceedingly hard and takes a finish comparable to steel. In order to match the finish standard for Hays steel panels, the Masonite panel is gone over with a sanding surfacer, then the priming coat is sprayed on and rubbed down to a smooth base. Then several coats of undercoater are sanded and rubbed. After drying, the finishing coats of black lacquer are sprayed on.

Vertical Rotary Pump

A NEW rotary pump, vertically mounted and powered by a 15-hp. gearhead motor is now being built by the Blackmer Pump Co., Grand Rapids, Mich.

General specifications include, capacity 100 g.p.m. at a pressure of 100 psi., handling Diesel fuel; pumping unit is all bronze construction; motor is standard gearhead type; 1770 r.p.m. reducing to 440 r.p.m. on the drive shaft. The base is fabricated steel, designed for bottom and back anchorage in mounting.

Practically all of these pumps are going into marine construction and they are built to meet full Navy specifications. They are used for pumping Diesel fuel on combat and escort craft. However, due to the small floor space required for mounting, this unit has been adapted for use in industrial plants requiring the transfer of oils and other non-abrasive liquids.

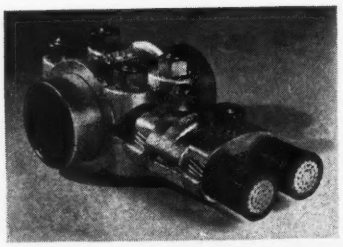
Two-Pen Flow Recorder

WHERE PANEL space is at a premium, or where it is desired to have two related flow records on the same chart for ready comparison, the Cochrane Corp., Philadelphia, Pa., has developed a new two-pen electric flow meter, which is actually two complete flow meter receivers mounted within one double depth case. Both receiver mechanisms can be swung out and operate in the swung-out position. The connection between the rear receiving mechanism and its pen arm must be detachable and is arranged with a self-alining V-notch junction.

Where two related measurements are involved, the operator can be guided by observing the coincidence (or lack of it) of the two pens. It is necessary in this case that he note which pen is which. Where continual reference must be made to this relationship of the two records, ratio indicating pointer can be incorporated. The rod target moves to right or left from the center point on the scale and shows at a glance whether there is an excess or deficiency of one of the quantities with respect to the other. The pointer movement is 2½ times greater than the difference between the two recording pens and is thus much more readily noted.

Electrical Power Connector

O. Z. ELECTRICAL MFG. Co., Brooklyn, N. Y., announces the new O. Z. Power Connector, Type KTC, a compact, flexible fitting made with 2 or 3-wire branch taps and taking a wide range of wire sizes.



Use of the Type KTC power connector is said to save time in installation and eliminate the additional connector equipment ordinarily required with a one-tap style connector. The interlocking clamp binds all strands tightly in the lug. Full conductivity, corrosion resistence and long service life are assured by the accurate machining of parts and the high copper alloy used in the manufacture of this connector.

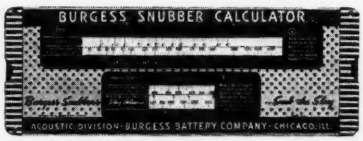
Copper Rule Calculator

A HANDY slide rule type calculator designed to show at a glance how much copper can be saved in a war plant electric power system by installing unit substations at the centers of the load areas has been announced by the General Electric Co., Schenectady, N. Y.

The rule uses a 1000 kv-a., 4160/480-v. unit substation as a basis and the reverse side of the rule carries a chart showing the per cent increase in cable copper as the voltage is decreased and another chart giving the cable copper needed to carry a 1000-kv-a. load at various voltages over distances from 10 to 1000 ft.

Snubber Calculator

A NEW slide rule, known as the Burgess Snubber Calculator, has been developed by the Acoustic Division of Burgess Battery Co., 2815 W. Roscoe St., Chicago, Ill., as a time saver for engine salesmen and operators in choosing the right size Burgess Exhaust Snubbers to provide quiet exhausts for their engines.

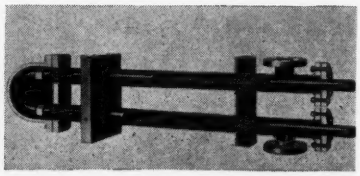


Since the proper selection of a snubber depends upon a number of different factors, it was previously necessary for interested persons to ask Burgess engineers to specify the correct size for each engine. This slide rule makes it easy for any engine operator to make a preliminary selection from the engine data.

Heat Exchangers

THE Brown Fintube Co., Elyria, Ohio, has announced that it will build and sell complete ready-to-use heat exchangers for the duration, as a service to buyers who are unable to get needed equipment from their usual sources of supply.

These heat exchangers will be built in all standard types, including the twin section unit pictured here, and in any capacity desired to meet practically any



heating and cooling requirement. Brown Fintubes, with their all-welded construction which provides an integral bond of metal between the fin and the central member, will be employed as the heat transfer tube in all cases. It is said that this will result in high thermal efficiency and trouble-free operation.

Decade Resistance Boxes and Wheatstone Bridge

WHEATSTONE Bridge and Type DR d.c. resistance decades are available in standard models with resistance ranges of .9 to 999,999 ohms total and with an accuracy of plus/minus 1 per cent and .1 per cent respectively, as announced by Industrial Instruments, Inc., 156 Culver Ave., Jersey City, N. J. All coils are of manganin wire excepting the 100,000 ohm coils of Nichrome, and are bifilar-wound on ceramic tubes, oven-baked and protectively-coated. Switches have self-cleaning multi-blade phosphor-bronze spring wipers. The instruments are housed in rubbed walnut cases.

Wheatstone Bridge Type RN-1 contains four resistance dials with nine positions each, covering 9x1, 9x10, 9x100, and 9x1000 ohms, with decade multiplying dials. The ratio resistances have an accuracy of plus/minus .05 per cent, while the resistance coils in the decades of the bridge are guaranteed to plus/minus .1 per cent tolerance.

ENLIST NOW

in the battle against power-waste!

● *Power-waste* **becomes** *productive-power* **when the Gilmer National Power-Recovery Plan goes to work in your plant. It gives you useful Power-Recovery Estimators . . . practical power-saving charts for each of these services: Electricity, Steam, Water, Gas, Mechanical Transmission, Compressed Air, Refrigeration, Boilers, and Prime Movers. Put them to work—today!**

The Gilmer Plan was designed especially to build up Industry's power resources through systematic reduction of power wastes. Into it has been knitted the expert knowledge of leading power engineers, the Plan is completely practical and workable.

Do you know for sure that your boiler room is working at top efficiency? Isn't it possible that you could cut electricity consumption, and still keep things humming at full speed? *Don't take chances with the Nation's precious power!* Line up with the Gilmer National Power-Recovery Plan . . . *NOW!* All in one convenient booklet, it's yours for the asking, without cost or obligation.

L. H. GILMER CO., Tacony, Philadelphia, Pa.

The Oldest Firm of Rubber Fabric Belt Specialists

USE WHAT YOU LOSE

Gilmer BELTS

If your problem is belts . . .

The Gilmer Handy Belt Selector is designed to help you choose the correct Gilmer Belt for any purpose. Use it when selecting V-Belts, Flat Belting, Round Endless Belts, Belts for Textile Machinery, and many special purpose belts . . . for added efficiency and an aid to power-recovery. Write for this handy Gilmer Chart—it's free on request.

L. H. GILMER CO.
Tacony, Phila., Pa.

Gentlemen:

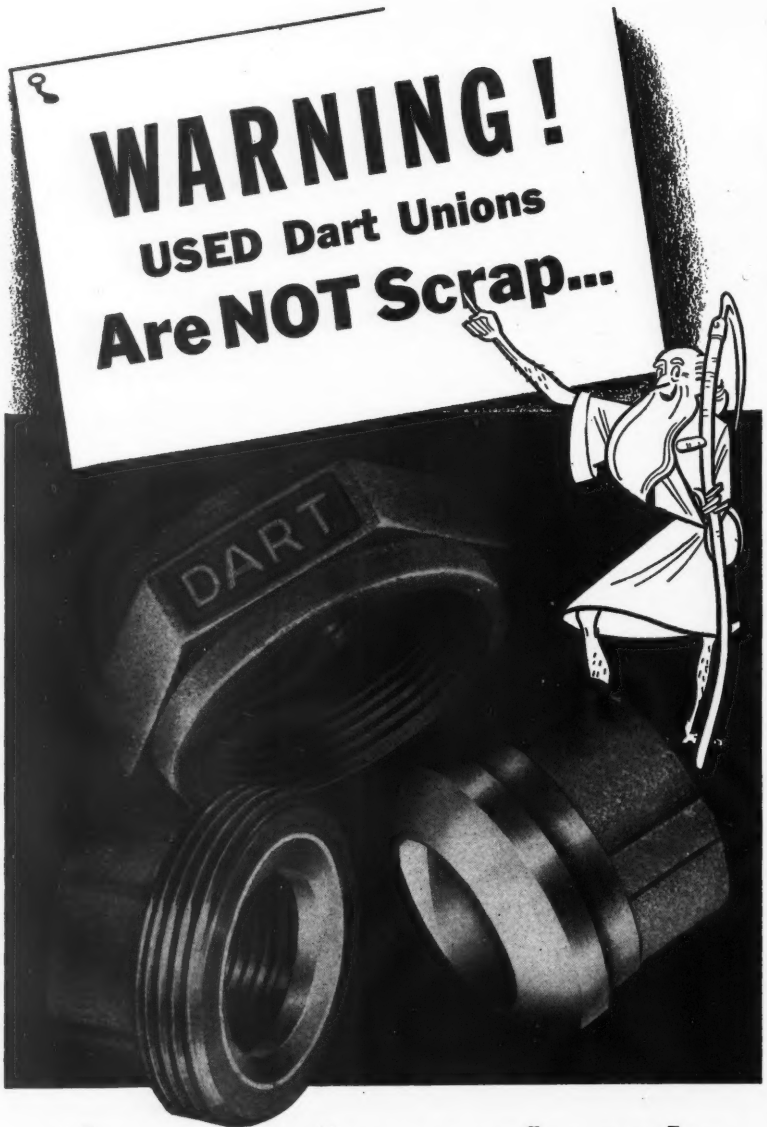
Please send me, without cost or obligation:

☐ The Gilmer National Power-Recovery Plan
☐ The Gilmer Handy Belt Selector

NAME & TITLE_____

COMPANY_____

ADDRESS_____



they can be used again

Every little bit of scrap counts for Victory. But by junking equipment that is needed and can be used again—such as used Dart Unions—you actually *delay* Victory. So don't throw away old Darts—put them back to work.

Know *why* Dart Unions can be used so many times, with such tight-joint performance—after ordinary unions have to be discarded? Darts have matched bronze seats, ground to true-ball surfaces for correct, leak-proof seating . . . clean-cut threads that prevent scoring . . . extra-heavy bodies and nuts made from air-refined malleable iron that withstands rough handling.

Your old Darts and new Darts make a great team. *Use* your old ones . . . see your supplier for new ones.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.

MANUFACTURERS' PERSONALS

Wheelco Instruments Co., Chicago, Ill., announces the appointment of Roger W. Allen as its southeastern district manager with headquarters at 305 Techwood Dr., Atlanta, Ga. Mr. Allen is a licensed professional engineer and for the past 6 yr. has been district sales engineer for The Foxboro Co. at Atlanta.

Robert H. Bishop, formerly eastern sales manager of the Lighting Division of Sylvania Electric Products, Inc., has been appointed General Sales Manager of the division, as announced by Don G. Mitchell, vice-president and director of sales for the company. Mr. Bishop succeeds Charles G. Pyle who recently resigned. He will have his headquarters at the company's offices at 500 Fifth Ave., New York, N. Y.

The Brown Fintube Co., Elyria, Ohio, manufacturers of resistance welded integrally bonded fintubes and heat exchangers, announces the appointment of B. DeLorenzo as manager of its Heat Transfer Department.

Mr. DeLorenzo is a graduate of Massachusetts Institute of Technology in chemical engineering and since then has been with the Foster Wheeler Corp. as laboratory technician and design engineer in the Oil Division, specializing on heat transfers and flows of fluids.

Yarnall-Waring Co., Philadelphia, Pa., announce the appointment of W. R. Hancock, 935 Park Ave., Rochester, N. Y., as their sales representative in the Rochester district, handling impulse steam traps.

The Crocker-Wheeler Electric Mfg. Co., Ampere, N. J., announces the appointment of W. L. Buchanan as field manager of Renewal Parts Sales with headquarters in the Chicago office. Mr. Buchanan's duties will consist of heading up all renewal parts sales.

Mr. Buchanan has been active in some of the early installations of automatic substations and in charge of installation and operations of all stations from coast to coast which were installed in the early 1920's. He started his career with the Westinghouse Electric & Mfg. Co. doing test work and later service engineering work in the Chicago area. Subsequently he was associated with the public utility industry and with the steel industry before joining the Crocker-Wheeler Co.

D. W. Haering & Co., Inc., Chicago, Ill., announces the appointment of Howard B. Graves as general manager. He joined the company in 1934 as senior technologist and was formerly the St. Louis district manager.

Evers, Commonwealth Edison Co. Vice-President

JOHN W. EVERS, secretary of Commonwealth Edison Co., Chicago, Ill., since 1924, was elected vice-president of the company on Dec. 17, 1942 to succeed John F. Gilchrist, who is retiring after 55 yr. of service to become

EQUIPMENT ★ FACILITIES ★ PERSONNEL ★ EXPERIENCE ★
REPUBLIC
INSTRUMENTS
AND CONTROLS

THE PROBLEM OF

Stretching Capacity

OF EXISTING BOILER EQUIPMENT

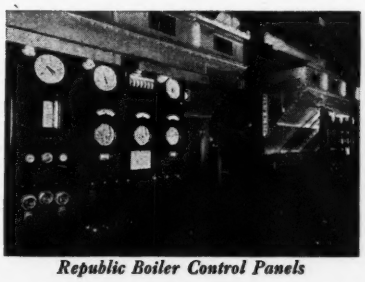
To the power engineer, industry's call for top-speed production is a call for more steam . . . a call which, in many plants, must be met by "stretching" existing generating capacity through shrewd operation, since new steam generating units are not immediately available.

The problem of "stretching" present capacity involves the acquisition of complete knowledge of existing conditions, so that losses in steam generation and distribution may be eliminated and optimum operating efficiency maintained. The correct solution depends on two fundamental procedures. First, the existing conditions must be determined by use of proper instruments. Second, the optimum conditions must be determined and maintained by the use of instruments and by proper methods of control.

Republic offers a complete line of power plant instruments and controls designed and built to meet today's power plant requirements. We will be glad to cooperate with you in the solution of any steam generation or distribution problem you may have.

AUTOMATIC COMBUSTION CONTROL

Republic-Smoot automatic combustion control systems are built for



Republic Boiler Control Panels

all sizes of boilers — all types of fuel firing equipment — all load conditions — any arrangement of draft equipment.

POWER PLANT INSTRUMENTS

Flow meters, draft instruments, CO_2 meters, thermometers — a complete line of power plant instruments, designed and built by Republic, for analyzing and checking plant performance.

BOILER WATER LEVEL CONTROL

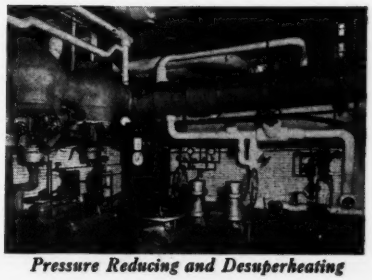
The Republic-Smoot boiler water level control system is designed to maintain boiler drum water level within ± 1 inch of the desired level when the boiler is operating under normal conditions.

REGULATING VALVES

Republic-Smoot turbine type valves are designed for regulating pressure and flow of high-pressure superheated steam or boiler feedwater. They are built for tough jobs in which the valve occupies a key position in the operation of a system or an entire plant.

DESUPERHEATERS

For control of steam temperatures in interconnected systems, several types of Republic-Smoot desuperheaters are available to meet special operating requirements.



Pressure Reducing and Desuperheating

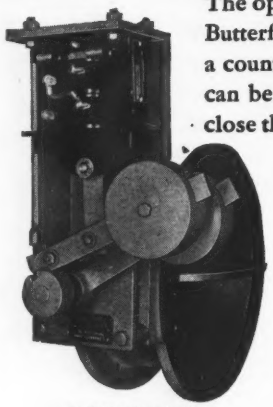
Whether your particular problem involves the use of a single instrument or the control of an entire process or plant, Republic engineers will be glad to study your problem and, in co-operation with your own engineers, make recommendations as to the most practical solution.

Your request for our co-operation in solving your power plant problems will involve no obligation on your part. Write us today.

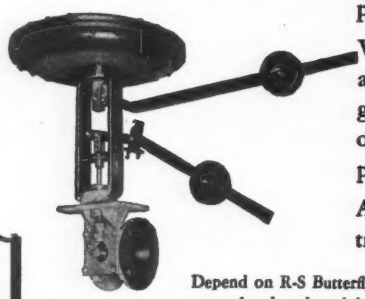
REPUBLIC FLOW METERS CO.
2224 Diversey Parkway, Chicago, Illinois

Emergency FIRE FIGHTERS

The operating solenoid in this assembly of an R-S Butterfly Valve connects to the valve vane through a counter-weighted lever and latch. The solenoid can be arranged with the mechanism to open or close the valve and hold it there in one position or the other. Failure in the current to the solenoid for any reason results in tripping the latch and permits the counter weight to close or open the valve by gravity. The assembly is suited for emergency use to shut-off flow wedge-tight or to open a vent. Used on sprinkler and foam systems, tank discharge, gas lines and for electrically driven blower protection.



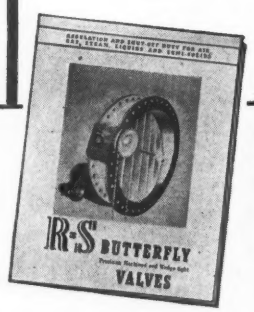
PATENT APPLIED FOR



Valve can be constructed of any alloy and in various sizes for air, gases, steam, oil, hydraulic and other services. Resetting is accomplished by hand.

A similar type trip valve can be controlled by pressure as illustrated.

Depend on R-S Butterfly Valves for low-cost, manual or automatic control and wedge-tight shut-off of volume and pressure. Suited for any pressure to 900 pounds. Sizes range from 2 to 84 inches.



Wafer (narrow face to face) valves are suitable for pressures up to fifteen pounds. They are light in weight yet high in regulating efficiency.

Write for Catalog No. 10-B.

BUTTERFLY VALVE DIVISION

R-S PRODUCTS CORPORATION

4535 Germantown Avenue • Philadelphia, Penna.

R-S Streamlined BUTTERFLY VALVES

Chairman of the Board of Directors of Chicago & Illinois Midland Railway Co., a subsidiary of Commonwealth Edison Co.

Mr. Evers has been with Commonwealth Edison Co. for 29 yr., and has had an important part in the administration of the company's employe pension and insurance programs and has served as a director of several Edison subsidiaries. As vice-president he will have charge of purchasing and stores and transportation departments and will continue as secretary.

Mr. Gilchrist was a pioneer in the electric light and power field, joining the Chicago Edison Co. only a few months after its formation in 1887 as the original predecessor of the present company.

New Vice-President of Foster Wheeler

THE Foster Wheeler Corp., New York, N. Y., announces the recent election of P. W. Foster, Jr., as vice-president. Mr. Foster has been with the corporation since its organization and before that with one of its antecedent companies.

Mr. Foster, a graduate of Princeton University, served as an artillery officer abroad during the World War. In 1919 he joined the Sales Department of Power Specialty Co. and progressed consistently, having charge of the Boston Office for some time. Later he directed the New York Industrial Department, and more recently the Steam Generation Division.

William C. Carter New Link-Belt President

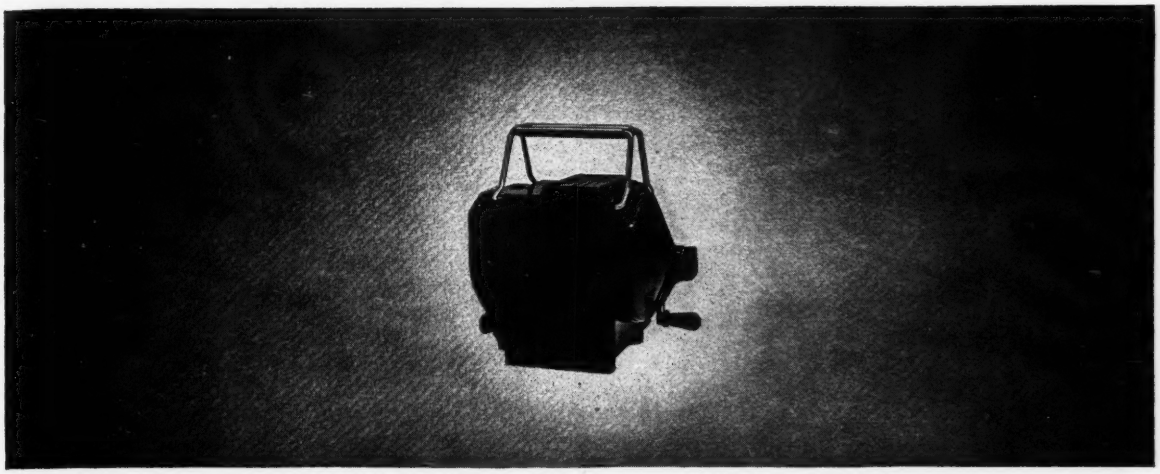
WILLIAM C. CARTER, for 14 yr. vice-president and for the past year executive vice-president of Link-Belt Co. has been elected president of the company to succeed Alfred Kauffmann who has resigned because of ill health.

Mr. Carter, a graduate of the Universtiy of Illinois, joined the Link-Belt Pershing Road Chicago plant organization in 1902 as a draftsman. He has consecutively held the position of engineering department supervisor, construction superintendent, plant superintendent, plant general manager, vice-president in charge of production and has been executive vice-president in complete charge of company affairs since Mr. Kauffmann's illness.

Mr. Kauffmann, who has been with the company for 41 yr., is retiring from active service but remains a member of the Board of Directors.

Chain Belt Co. Personnel Changes

A. R. ABELT, secretary of Chain Belt Company, was recently elected a director of the company to succeed F. J. Weschler who died recently. Mr. Abelt was also elected a vice-president of the company.



To Our Customers and Friends:

"Megger" Testers are, as you can well imagine, in unusually heavy demand during these strenuous days. Now, if ever, electrical equipment *must not fail*.

Although the demand has been for a quantity of instruments many times larger than our normal pre-war volume, we have so far been able to fill most high priority orders on schedule. Ours is the unique responsibility of supplying America's electrical men who must maintain electrical equipment on land, on the seas and in the air—with a testing device that is a vital necessity.

To this end we are now concentrating on the building of the more generally used types of "Megger" instruments in our Philadelphia factory We have complete manufacturing facilities, a loyal group of skilled men and women, and above all the *determination* to see that you get all the "Megger" Testers you need—at the earliest possible date.

JAMES G. BIDDLE CO.
January, 1943

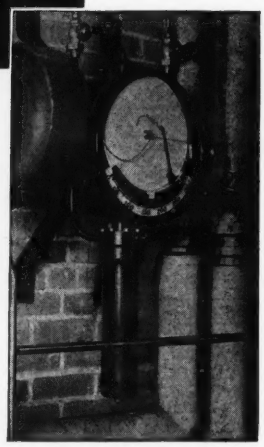
P.S.—*We urge you to inform us as soon as possible of your requirements for "Megger" instruments, so that we can plan our production to meet your needs.*

"MEGGER"
TRADE MARK REGISTERED U.S. PAT. OFF.
INSULATION TESTERS · GROUND TESTERS · OHMMETERS

JAMES G. BIDDLE COMPANY · 1211-13 ARCH STREET · PHILADELPHIA, PENNA.

LET THIS METER HELP

STRETCH YOUR STEAM



● The unprecedented demand for steam, coupled with the difficulty of obtaining new generating equipment, makes it essential to stop waste and squeeze every pound of steam from present generating equipment.

To do this most effectively, you need ADSCO Steam Flow Meters. They provide information that will enable you to

1. Establish the proper load distribution among boilers.
2. Center attention on the department or unit using excess amounts of steam.
3. Coordinate steam consumption with steam production.

In these ways, it may be possible to regulate your steam supply sufficiently to carry you through this critical period.

ADSCO Steam Flow Meters record and totalize on direct reading evenly divided charts, with exceptional accuracy at all rates of flow. They can be used for steam, water, compressed air or gas.

Write us regarding your meter problems—also, ask for Bulletin No. 35-83E.

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, NEW YORK

MAKING "UP-TO-DATE" STEAMLINE EQUIPMENT FOR OVER 60 YEARS

LET ADSCO FLOW METER TELL YOU HOW MUCH . . . WHEN . . . WHERE

Mr. Abelt joined Chain Belt in 1907 and has served in many capacities including production, sales and executive work. In 1922 he was made sales manager of the Chain Belt and Transmission Division, a position which he held until early in 1942 when he became manager of that division. He has been secretary of the company since 1930.

G. D. Gilbert, sales manager of the Baldwin-Duckworth Div. of the company, at Springfield, Mass., has been made general manager of that division and also elected secretary to succeed Mr. Abelt. Mr. Gilbert entered the employ of the Duckworth Chain and Mfg. Co. in 1918 and has been with that company and the Baldwin-Duckworth Division of Chain Belt Co. since its creation in 1939. He is also a director of Chain Belt Co.

Donaldson, New Associate Of Gibbs & Hill, Inc.

RODERICK D. DONALDSON, former vice-president of the Utility Management Corp., has become associated with Gibbs & Hill, Inc., Consulting Engineers of New York City, as head of a department to render advisory and supervisory services to operating utilities, as announced recently by E. R. Hill, president of the company.

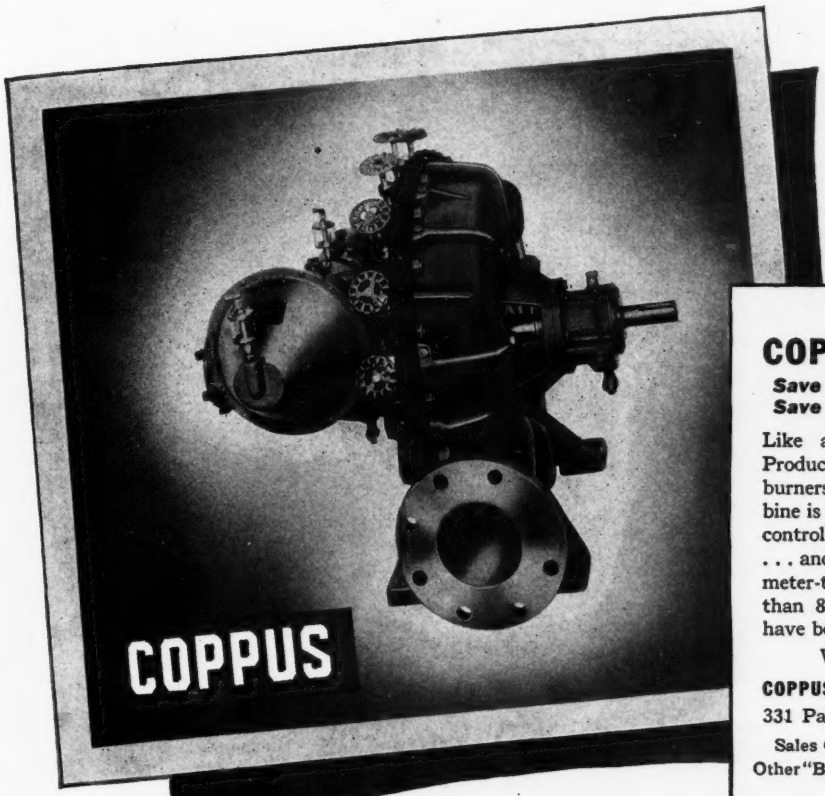
Mr. Donaldson has been associated with public utilities since his graduation from Cornell University in 1907 and in his new position will be in charge of a new department established by Gibbs & Hill to meet a need resulting from the current trend toward decentralization in the utilities industry. The development of a large number of independent utility systems which no longer have available the advisory departments of affiliated service companies brings about the need for an operating advisory service which Mr. Donaldson will provide.

MANUFACTURERS' NEWS

Thomas C. Wilson, Inc., manufacturer of tube cleaners and tube cleaning accessories, has moved its offices and plant to new and larger quarters at 21-11 44th Ave., Long Island City, N. Y.

The McClave Co., Allentown, Pa., manufacturers of stokers and grates, announces the consolidation of its Philadelphia District Territory with Maryland and Delaware, exclusive of the District of Columbia. This new territory will be known as the Middle Atlantic District Sales Territory. Harry S. Barager, the present Philadelphia District Sales Manager, and E. C. Sholler, manager of sales for Maryland and Delaware, will be in charge of the combined territories with headquarters at 1600 Arch Street, Philadelphia, Pa.

The Midwest Machinery Co., 8029 Forsythe Blvd., St. Louis, Mo., has been oppointed sales representative of the Roto Co., Newark, N. J., in the southern part of Illinois and the eastern and southern parts of Missouri.



COPPUS TURBINES

Save Metal in Wartime — Will Save You Money in Peacetime

Like all Coppus "Blue Ribbon" Products (blowers, ventilators, gas burners, etc.), the Coppus steam turbine is a precision-made product . . . controlled by Johansson size blocks . . . and every turbine is dynamometer-tested before shipment. More than 85% of all orders since 1937 have been repeat orders.

Write for Bulletin 135-9

COPPUS ENGINEERING CORPORATION
331 Park Avenue, Worcester, Mass.

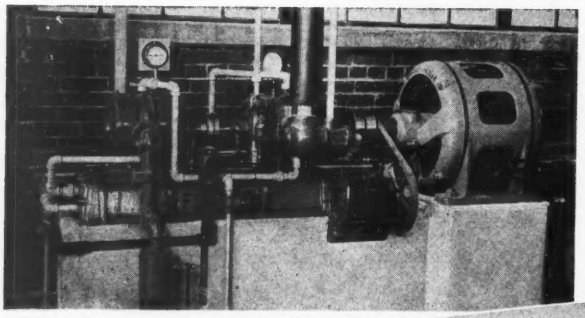
Sales Offices in THOMAS' REGISTER
Other "Blue Ribbon" Products in SWEET'S

BLUE RIBBON PRODUCTS
DESIGNED FOR YOUR INDUSTRY...ENGINEERED FOR YOU

If a COPPUS "Horse Power" Steam Turbine can power your pump, blower, fan, stoker, dryer, mixer, etc. . . . then you'd waste money and metal buying an "Elephant Power" Turbine. COPPUS Blue Ribbon Turbines come in 6 frame sizes; matching size to job saves critical metal for war and money for yourself.

And the blue ribbon means workmanship that promises peak performance.

Four Years' Operation . . . No Maintenance Expense



February 23, 1942.

The Fuller Company,
Catasauqua,
Penn., U.S.A.

Attn: Mr. E. P. Meixwell

Gentlemen:

In January 1938 we purchased a two-stage Fuller Rotary Compressor Size C-16-16H, and since installation it has run 23 hours per day almost continuously and has given no trouble.

As we are dependent upon an air supply for a number of operations and would be greatly inconvenienced in case of machine failure, we are considering the possible need of machine spare parts which could be used in case of a breakdown.

Are there such parts which experience has shown may need replacement due to wear or breakage, and which should be kept in stock, especially in view of the present and future industrial conditions which might make the replacement more difficult to obtain?

Your recommendations in this connection would be greatly appreciated.

Yours very truly,

YOUR COMPRESSORS spot WHERE YOU NEED THE AIR

Here's a letter that tells a story better than any words we could use. Nor is it an exceptional case . . . hundreds of users of Fullers are reaping the same benefits. It further strengthens the claims we have been making, that you too can profit by installing Fuller Rotary Compressors and Vacuum Pumps.

There's every logical reason for long, continuous service with these units. Simple, sturdy construction; a minimum of moving parts—rotor, bearings, blades.

In these times when shut-downs are costly . . . lost time can never be recovered . . . it's up to you to see that the very best equipment is installed in your plant.

FULLER COMPANY

CATASAUQUA, PENNSYLVANIA

Chicago: 1144 Marquette Bldg. San Francisco: 421 Chancery Bldg.

C-70

FULLER-KINYON, FLUXO, AND AIRVEYOR CONVEYING SYSTEMS · · · ROTARY FEEDERS AND DISCHARGE GATES
ROTARY AIR COMPRESSORS AND VACUUM PUMPS · · · AIR-QUENCHING COOLERS · · · BIN SIGNALS

Kaiser Interest Buys Crocker-Wheeler

CROCKER-WHEELER ELECTRIC MFG. CO., Ampere, N. J., has announced that its stockholders, at a special meeting at Ampere, N. J., on Dec. 10, 1942, have approved the sale of the company to the Joshua Hendy Iron Works of Sunnyville, Calif., for $3,200,000. The stockholders of Joshua Hendy Iron Works are all in the Henry J. Kaiser group. According to Charles E. Moore, president of the Hendy organization, it is now the country's largest producer of vertical marine engines for Liberty ships, producing at the rate of one engine a day. In addition, the Hendy company plans to go into the production of turbines.

The name of Crocker-Wheeler Electric Mfg. Co. will be retained, Mr. Moore states, but specialized personnel will be added and production operations on war materials speeded up. In the meantime, the Crocker-Wheeler Liquidating Co. will be formed to distribute proceeds of the sale to C-W stockholders. Edward S. Perot is president of the Crocker-Wheeler organization.

The combination of Crocker-Wheeler, says Mr. Moore, is an outstanding example of bringing together two companies, each contributing to the war effort, in such a way that their total contribution will be greater than the sum of the parts. The two companies represent a total of 140 yr. of experience in the mechanical and electrical fields.

NEWS FROM THE FIELD

J. Kenneth Salisbury, of the General Electric Turbine Engineering Department, was awarded the A.S.M.E. Melville Medal for his paper, "The Steam-Turbine Regenerative Cycle—An Analytical Approach," on December 2 during the annual meeting of the Society. Mr. Salisbury has been with General Electric since 1930 and has been with the Turbine Engineering Department since 1933.

The Melville Medal is awarded each year by the Society to the member who has written the most original paper or thesis on a mechanical engineering subject.

New Award Program by Lincoln Foundation

THE James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, announces its first award program in the field of under-graduate engineering study, the $6750 Annual Engineering Under-graduate Award and Scholarship Program for the purpose of encouraging engineering students to study arc welded construction so that their imagination, ability and vision may be given opportunity to extend knowledge of this method and thus aid the war effort and the economic reconstruction in the peace which is to follow.

The program offers $5000 in student awards and $1750 in scholarships

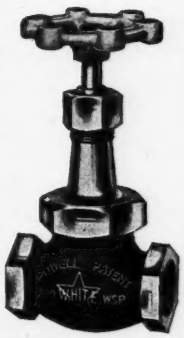
POWELL *has them all*

The history of the Powell Line is written in the amazing evolution of American Industry, because for nearly a century Powell has been meeting and satisfying every demand imposed by each new process or development in the industrial world.

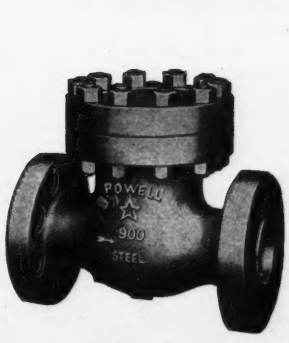
Big valves, little valves . . . valves for high pressures, low pressures . . . for varying temperatures . . . for corrosion resistance. Globes, gates, checks, reliefs, non-returns, Ys, angles . . . in iron, steel, bronze, pure metals and special alloys—*Powell has them all.*

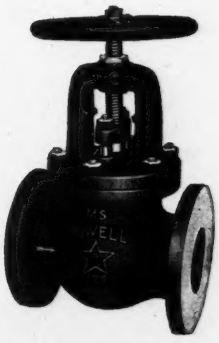
Shown here are a few examples of the many Powell Valves evolved by our Research Engineering Staff to meet some particular requirement. Having completely fulfilled it, they have taken their place in the Powell line.

Today, for every known demand, Powell has the answer. And, as new problems arise in the future, Powell Engineering will be ready and able to solve them. In either case Powell Quality costs no more in the beginning and saves in the long run.



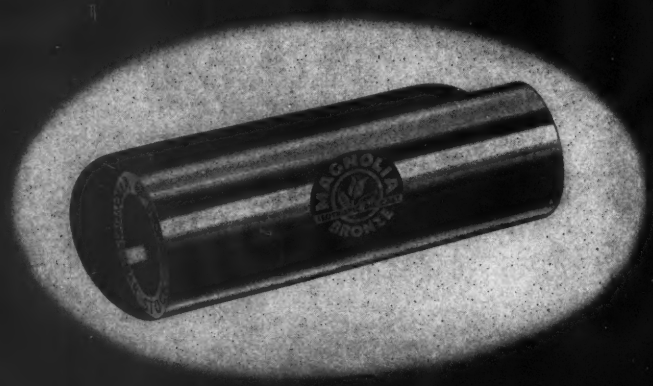
The Wm. Powell Co.
Dependable Valves since 1846
Cincinnati, Ohio





POWELL VALVES

SPECIAL CASTING METHOD MAKES VITAL BRONZE WEAR LONGER



Magnolia Isotropic Bronze is die-cast by our exclusive crystal control method which produces a more homogeneous structure than that of ordinary bronze bearing stock. Magnolia Bronze is stronger and stands much greater strains. It presents a uniform bearing surface which is free of blow holes, cracks or spongy material and wears longer than any sand cast bronze. The die casting process produces bars free of tiny, hard sand particles which might ruin valuable cutting tools and wear shafts like sandpaper.

700 stock sizes... cored or solid bars... fully machined, inside, outside and on the ends... Ultimate Strength, psi, 31,250 • Yield Point, psi, 26,000 • Elongation in 2", 8.5% • Brinell 70.

Write for Bulletin

MICROPHOTOS SHOW THE BIG DIFFERENCE

Left — ordinary sand cast . . . right — Isotropic die-cast . . . both from same heat. Note spongy structure, segregrated lead and white Cu-Sn crystals of the sand cast specimen as compared to absence of segregation and complete dentritic crystallization of die-cast bronze.

MAGNOLIA METAL COMPANY • ELIZABETH, N. J.

MAGNOLIA

Isotropic Die-cast

BEARING BRONZE

BY THE MAKERS OF MAGNOLIA ANTI-FRICTION METAL

for the departments of the institutions in which the award-winning students are registered. These awards are divided as follows: 77 student awards—a first award of $1000, second of $500, third of $250, four awards of $150, eight of $100, twelve of $50 and fifty of $25. There are seven scholarships of $250 each. The school of the first award winner will receive four scholarships totalling $1000; the school of the second winner two scholarships totalling $500; and the school of the third winner one scholarship of $250. The winning students will receive an additional honor, since the scholarship in his school will be given his name.

Any resident engineering undergraduate student registered in any school, college or university in the United States giving a course in any branch of engineering or architecture which leads to a degree, or any cadet registered in the United States Military Academy, Naval Academy and Coast Guard Academy is eligible to submit a paper. The awards will be made for papers describing the conversion from other methods to arc-welded construction of parts of machines, complete machines, trusses, girders or structural parts. The subject may be something which the student has observed in school shops, magazines, books, printer matter, or he may conceive a subject which has never been built but could be built by arc welding and the paper must describe the method of construction or design.

Papers may be submitted by any group of students, but only one paper may be submitted by any one group, and each author must have an actual part in the writing of the paper.

If the paper covers a project, the project may have been started before December 1, 1942, but it must be completed by April 1, 1943.

For further details write The James F. Lincoln Arc Welding Foundation, P. O. Box 5728, Cleveland, Ohio.

The American Foundrymen's Association announces its 47th annual meeting, which will be staged in St. Louis, Mo., April 28, 29, 30, 1943, and will be a mobilization of management, technical and operating men for the purpose of devising ways and means for extending the use of cast metals in the war effort. Hotels Jefferson and Statler have been designated as joint headquarters for meetings with the registration headquarters located at Hotel Jefferson.

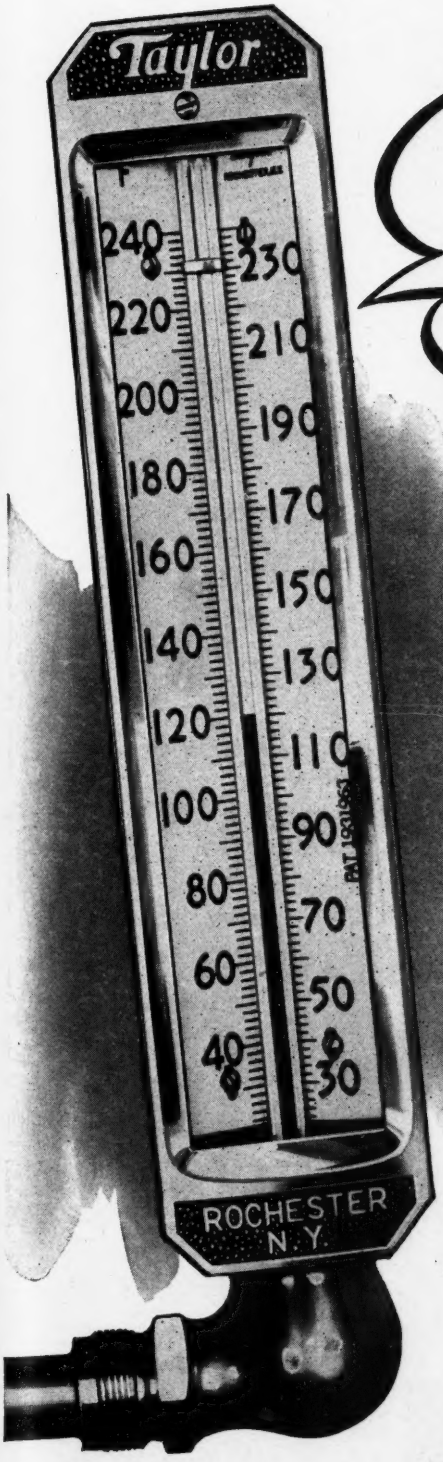
A.S.H.V.E. Meeting In Cincinnati

THE 49th Annual Meeting of the American Society of Heating and Ventilating Engineers will be held January 25-27 at the Hotel Gibson, Cincinnati, Ohio.

The program will include subjects of wartime interest, such as fuel conservation, food dehydration, manpower problems, warship ventilation and physiological studies affecting efficiency and health. A special panel discussion of the subject, "How to Keep Fit in Cold Homes" will be a feature of one session.

Four technical sessions will be held, beginning January 25, and several research papers will cover studies of heating plant operation with reduced night temperatures, resistance of various building

A THERMOMETER THAT TALKS!



COME AND READ ME!

IT'S the truth! Taylor Industrial Thermometers actually INVITE you to take frequent readings. Why? Because they're *3 times easier to read*—a real advantage these days when you've got so much else on your mind. The reason is, of course, Taylor BINOC tubing. Instead of squinting at it like ordinary tubing, you can read BINOC tubing easily with both eyes. Here's why—

1. OPTICALLY CORRECT *for easy reading.*

2. WIDE ANGLE OF VISION - HIGH MAGNIFICATION. *You can see the broad, clear mercury column through more than twice the usual angle.*

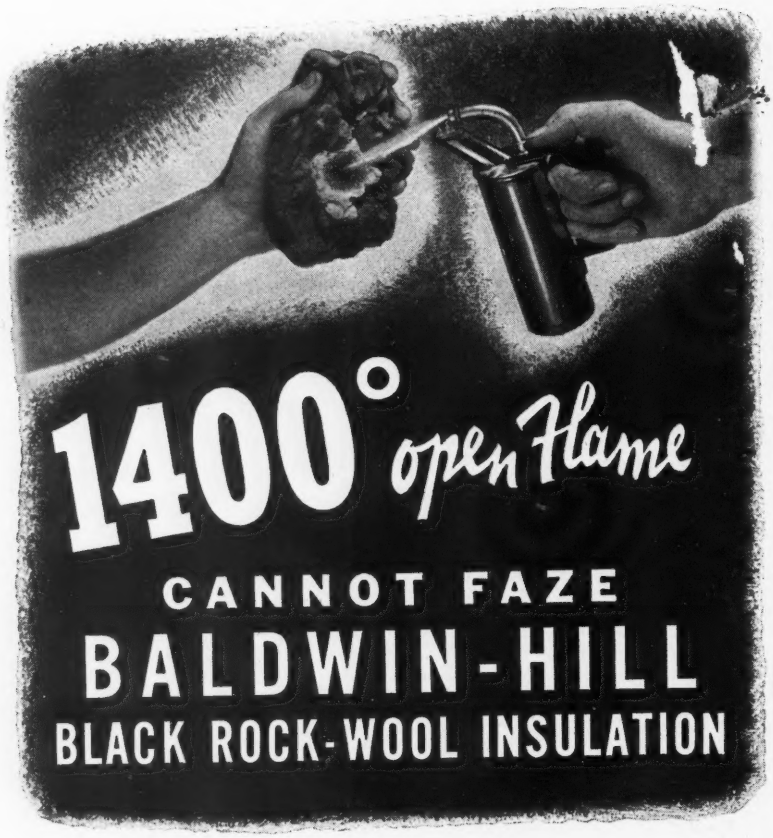
3. THREE LENSES *gather 3 times the light. Highly magnified mercury column stands out in sharp relief.*

4. NO CONFUSING BORE REFLECTIONS. *Empty bore above column never appears to contain mercury.*

Numerals and graduations are exceptionally legible. Taylor Industrial Thermometers with easy-to-read BINOC tubing can be supplied in numerous standard ranges within limits of —40° and +950° F., with a variety of stem constructions to fit any need. Call your Taylor Field Engineer! Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording, and controlling temperature, pressure, flow, humidity, and liquid level.*

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

★ KEEP ON BUYING U. S. WAR BONDS AND STAMPS ★

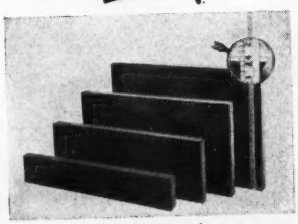


THE HIGH-IRON, low-alkaline nature of Baldwin-Hill rock wool is undisturbed by temperatures as high as 1400°. Exposures which completely remove the resiliency and strength from ordinary rock wool, flames which eat right through white wools, don't touch the strength or insulating power of Baldwin-Hill products. Add to that their stability in the presence of moisture, and you have two vital reasons for investigating Baldwin-Hill wools, felts, blocks, and cements—at once.

B-H

FREE TO POWER-PLANT MEN

A generous sample square of Baldwin-Hill Mono-Block, the one block for all temperatures up to 1600°, together with a sample of B-H Bond-Tite, the easy adhesive which makes wiring unnecessary. Test for yourself the heat-resistance, the extraordinarily low conductivity, the quick adhesion, and ease of cutting of this universal insulation. Just write us on your letterhead.



BALDWIN-HILL *Insulations*

577 KLAGG AVE. NEW YORK — CHICAGO — TRENTON, N. J. KALAMAZOO

materials to vapor transmission, and performance of air duct outlets.

The members of the Committee on Arrangements are: W. C. Green, honorary chairman; Albert Buenger, general chairman; A. L. Hard, vice-chairman; G. V. Sutfin, secretary; W. H. Junker, finance; K. A. Wright, publicity; Mrs. G. B. Houliston, ladies; I. B. Helburn, banquet; G. B. Houliston, entertainment; H. E. Sproull, reception; W. W. Edwards, transportation; and M. E. Mathewson, inspection trips.

C. R. Logan, President of A.S.R.E.

CHARLES R. LOGAN, representative of the Superior Valve & Fittings Co., Pittsburgh, Pa., was elected president of The American Society of Refrigerating Engineers, and was inducted into office on December 2 at the closing session of the Society's 38th Annual Meeting at the Hotel Commodore in New York City. Mr. Logan succeeds in office Dr. William R. Hainsworth, vice-president of Servel, Inc.

Other new A.S.R.E. officers include: vice-president, A. B. Stickney, engineer, Armour & Co., Chicago, Ill.; vice-president John F. Stone, manager, Refrigeration Division, Johns-Manville Corp., New York, N. Y.; and treasurer, John G. Bergdoll, Jr., chief engineer, York Ice Machinery Corp., York, Pa.

Directors elected by the A.S.R.E. to serve for a 3-yr. period are: Charles S. Leopold, consulting engineer, Philadelphia, Pa.; Lee C. Leslie, Johns-Manville Corp., Philadelphia, Pa.; Nels Rosberg, production manager California Consumers' Corp., Los Angeles, Calif.; Arthur B. Schellenberg, president, Alco Valve Co., St. Louis, Mo.; Mack Tucker, University of Tennessee Knoxville, Tenn.

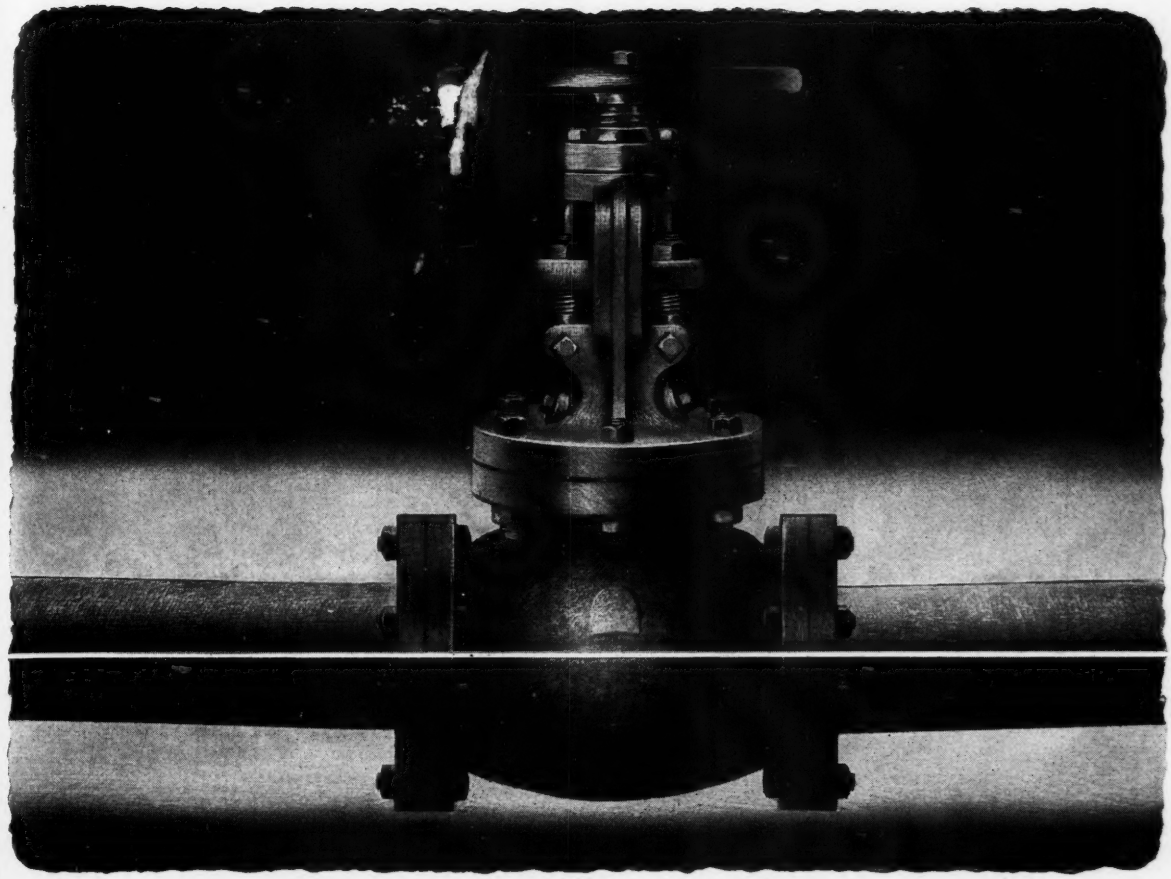
Belting Association Elects New Officers

AT ITS annual meeting in New York, Dec. 4, the American Leather Belting Assn. elected the following officers: Roy C. Moore, Charles A. Schieren Co., New York City, president; George L. Abbott, Graton Knight Co., Worcester, Mass., vice-president; Arthur H. Rahmann, George Rahmann & Co., New York City, treasurer. The following new members were elected to the Board of Directors: C. Carter Bond, Charles Bond Co., Philadelphia, Pa.; Roy C. Moore, Charles A. Schieren Co., and Frank F. Raniville, F. Raniville Co., Grand Rapids, Mich. The following members of the Board were re-elected: George L. Abbott, Graton Knight Co.; Edward H. Ball, Chicago Belting Co.; P. J. Slowey, Holyoke Belting Co.; Major A. E. Carpenter, E. F. Houghton & Co., and Wm. T. Bell, Page Belting Co.

OBITUARIES

Bennet B. Bristol

BENNET B. BRISTOL, treasurer of The Foxboro Co., died at his home in Falmouth Heights, Mass., November 10. He was born in 1868 and graduated from Stevens Institute of Technology in 1893. In 1908, with his brother, Edgar H. Bristol, he founded the Industrial Instrument Co. which later became The Foxboro Co. and has been actively associated with the company since that time.



GUARD YOUR VALVES GIVE THEM PROPER SUPPORT!

PROVIDE EXPANSION BENDS OR JOINTS

Don't so install valves that they carry the weight, sag or expansion of the line. Valves are not designed to carry that type of load. Distortion will result in inefficient operation, jamming, and need for early maintenance. Maintenance materials, you must remember, also are on the critical list.

It might be a good idea to approach inspection of every valve with one thought, *"What's wrong with this?"* Guard your valves. They will last longer.

Don't Use Gate Valves or Cocks for Throttling . . .

Gate Valves and Cocks should be opened wide and closed tight. When operated otherwise they are soon ruined, giving unsatisfactory service in the meantime. Use Globe and Angle Valves for throttling.

Write to Reading, Pa., general office, for copy of "VALVE DON'TS" —a poster for plant use that tells things NOT to do to valves.

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READING CAST STEEL VALVES AND FITTINGS
PRATT & CADY BRASS AND IRON VALVES
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A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT, CONNECTICUT

Frank J. Weschler

FRANK J. WESCHLER, vice-president of the Chain Belt Co. and general manager of Baldwin-Duckworth, a division of Chain Belt Co., at Springfield and Worcester, Mass., died suddenly on November 10 in Worcester.

Mr. Weschler became affiliated with the Baldwin Chain & Mfg. Co. of Worcester as president and treasurer in 1927 and upon the merger of that company with the Duckworth Chain & Mfg. Co. in 1930 became treasurer and general manager of the newly formed Baldwin-Duckworth Chain Corp. When Baldwin-Duckworth merged with the Chain Belt Co. in 1939, Mr. Weschler became vice-president of Chain Belt and general manager of the Baldwin-Duckworth Division.

David S. Youngholm

DAVID S. YOUNGHOLM, vice-president of the Westinghouse Electric & Mfg. Co. in charge of the Lamp Division at Bloomfield, N. J., died recently at the age of 53.

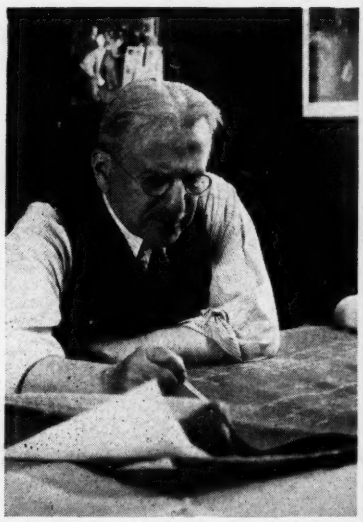
Mr. Youngholm was born in New York City in 1889 and attended school in Kearny, N. J. In 1909 he joined the Westinghouse Lamp Co. in Bloomfield and in 1920 was placed in charge of production. In 1923 he was made assistant manager of sales and in 1924 assistant general superintendent. In 1930 he became assistant to the vice-president of the Lamp company and in 1936 was made vice-president.

During his 33 yr. with Westinghouse, Mr. Youngholm became nationally known in the lighting industry. In 1936 he was awarded the Silver "W" Order of Merit in recognition of "unusual foresight energy and tact in the management of the Lamp company," the highest award given by the company in acknowledgment of outstanding services.

At the time of his death, Mr. Youngholm was governor of the Electrical and Gas Association of New York and also a member of the Illuminating Engineering Society and the Essex Club of Newark. He is survived by his widow and two brothers, William of Tampa, Florida, and Albin of San Francisco.

Albert Kahn

ALBERT KAHN, head of Albert Kahn Associated Architects & Engineers, Inc., Detroit, Mich., died at his home in Detroit on December 8, 1942. When the end came he was in the midst of a great program of war plant construction. Since the present emergency arose, his organization has built such plants as the Detroit (Chrysler) Tank Arsenal, Wright Aeronautical plants, Ford Bomber plant, Glenn L. Martin plants, Curtiss-Wright plants, Pratt and Whitney plants. It was chosen by the Bureau of Yards and Docks to design the Naval bases at Midway Island, Honolulu, Alaska, Puerto Rico, Jacksonville and other points.



Beginning in 1928, Albert Kahn engineers built 521 factories in Russia alone and trained some 4000 Soviet engineers and others to operate them.

During World War I, Mr. Kahn designed Army air fields, Naval bases, cantonments, and other buildings for the nation's armed forces.

His architectural firm was chosen by Packard, Ford, General Motors, Chrysler, Hudson and others to build mass production plants for the automobile industry. Using reinforced concrete frame and steel sash, he produced for Packard the first factory of its kind in America and introduced a new form of industrial architecture to the world.

Nor were all his achievements in the industrial field. His architectural work is seen in such other structures as the General Motors Building, Fisher Building, New Center Building, numerous buildings for the University of Michigan, Detroit Free Press Building, Detroit News Building, Detroit Times Building, S. S. Kresge administration building,

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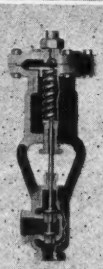
TYPE 4357 . . Pilot Operated Pump Governor. Size ½" to 6". For Discharge Pressures to 1000 lbs.

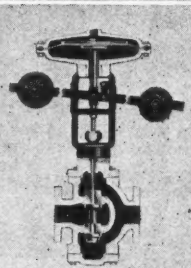
TYPE 301 . . Constant Hydraulic Pressure Governor. Size 1" to 6". For Discharge Pressures to 9000 lbs.

TYPE 57 . . Constant Pressure Diaphragm Actuated Governor. Size ½" to 6". For Discharge Pressures to 100 lbs.



TYPE 53 . . Constant Pressure Oil Pump Governor. Size ½" to 4". For Discharge Pressures to 200 lbs.

TYPE 444 . . Excess Pressure Governor. Size ½" to 6". For Differential Pressures to 100 lbs.



TYPE 84 . . Vacuum Pump Governor. Size ½" to 6". For All Vacuum Conditions.

TYPE 1 . . Constant Pressure Governor. Size ½" to 6". For Discharge Pressures to 500 lbs.

Fisher Engineers will gladly recommend the correct type and size for your particular requirements.

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Take the feature illustrated above—the tangents. These straight segments on each end of every WeldELL keep the weld out of the zone of greatest stress—conform to best engineering practice. But, equally important, they also make it easier for the welder to line up the job and weld it properly.

Check down the list of WeldELL features and you will find that WeldELLS give you the means of doing every job as *well* as it can be done—as *easily* as it can be done—and therefore as *economically* as it can be done!

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No other fittings for pipe welding combine these features. In addition to tangents these features are:

- **Seamless** — greater strength and uniformity.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement**—provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provide best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

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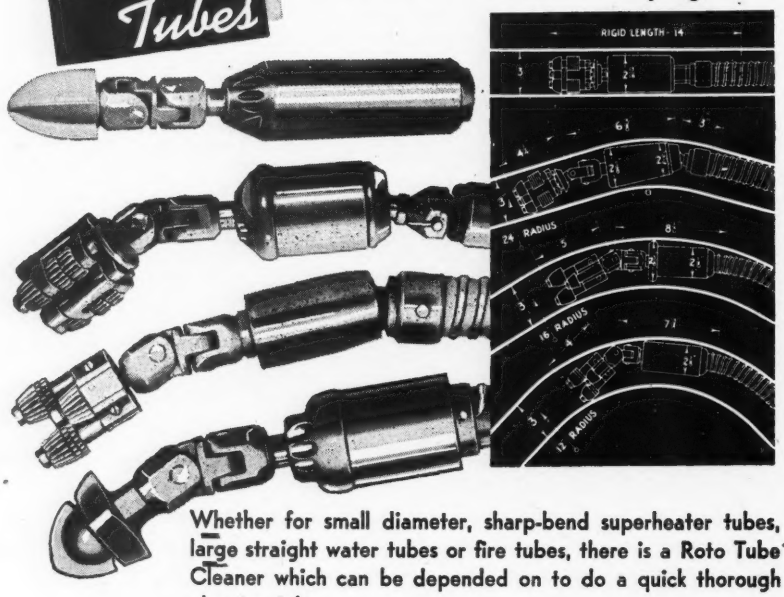

Whether for small diameter, sharp-bend superheater tubes, large straight water tubes or fire tubes, there is a Roto Tube Cleaner which can be depended on to do a quick thorough cleaning job.

Roto equipment includes air-, steam- and water-driven types for inside tube diameters from 1/2" up. Cutter heads in a wide variety of shapes as well as scrapers and brushes are available for cleaning every kind of deposit, hard, soft or gummy.

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Maccabees Building, Detroit Athletic Club, YMCA and YWCA buildings, units of Harper, Grace, Woman's and Herman Kiefer hospitals, and in many others.

Albert Kahn was born in Rhaunen, Germany, March 21, 1869, came to America at the age of 11 and soon thereafter got his first job as an errand boy in an architect's office.

Twenty years ago Albert Kahn gave the key men in his organization an interest in the business and began to train them to carry on after he was gone. This policy, continued without interruption, culminated about 2 yr. ago in the incorporation of the firm as Albert Kahn Associated Architects and Engineers, with 25 associate members.

Allan D. Skinner

ALLAN DAVID SKINNER, 68, president of Skinner Engine Co., Erie, Pa., died December 4 after a brief illness. Forty-seven years ago, he entered the employ of the company; and, in 1924, upon the death of his father, the late LeGrand Skinner, founder of the company, he succeeded to the presidency.

Mr. Skinner is survived by Mrs. Skinner, a daughter, Allene, and a son, J. LeGrand, who will continue as active head of the company; and two granddaughters.

Harte Cooke

HARTE COOKE, senior engineer of the Diesel Engine Division, American Locomotive Co., Auburn, N. Y., died at his home in Auburn on Dec. 14, 1942, after an illness of three weeks. He was 71 yr. old.

Mr. Cooke was born in Whitehall, N. Y. He attended Rensselaer Polytechnic Institute, Troy, N. Y., and in 1892 went to Aubrun as a draftsman for McIntosh & Seymour Corp., builders of steam engines. The corporation began building Diesel engines in 1913. By that time, Mr. Cooke had become a member of the firm. In 1929 the corporation became associated with American Locomotive Co.

During the first World War, Mr. Cooke was a member of the United States Shipping Board. He lectured frequently on the Diesel engine at Rensselaer Polytechnic Institute, Yale, Princeton, Purdue, Lehigh, the Universities of Ohio, Michigan, Iowa and Illinois and at Carnegie, Worcester Polytechnic and Rice Institutes.

At the time of his death he was an instructor of U. S. Navy personnel stationed at Cornell University and was a member of the National Defense Research Committee.

He was vice-president of the A.S.M.E. in 1937 and served for 20 yr. as a member of its Power Test Codes Committee. He was also vice-president of the S.A.E. in 1933 and a member of the American Association for the Advancement of Science.

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FIG. 0601
Bronze Check

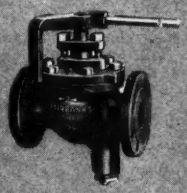


FIG. 0851
Ball-Plug Type

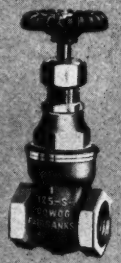


FIG. 0250
Bronze Gate

FIG. 0702
Iron Body Check

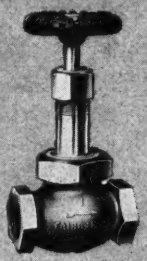


FIG. U-01
Bronze Globe,
Union Bonnet

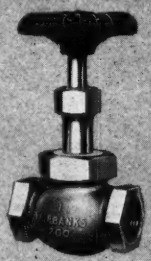


FIG. 0501-P
Bronze Regrinding
Globe

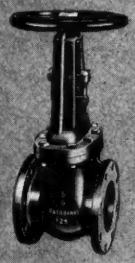


FIG. 0405
Iron Body Gate

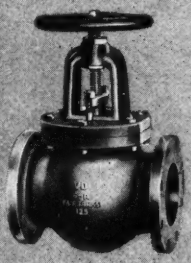
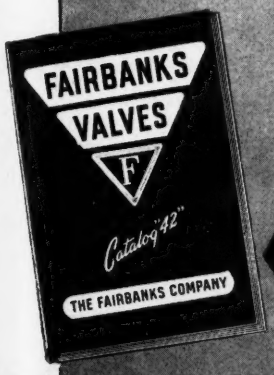


FIG. 0102
Iron Body Globe

FIG. 0418
U-Bolt
All-Iron Gate



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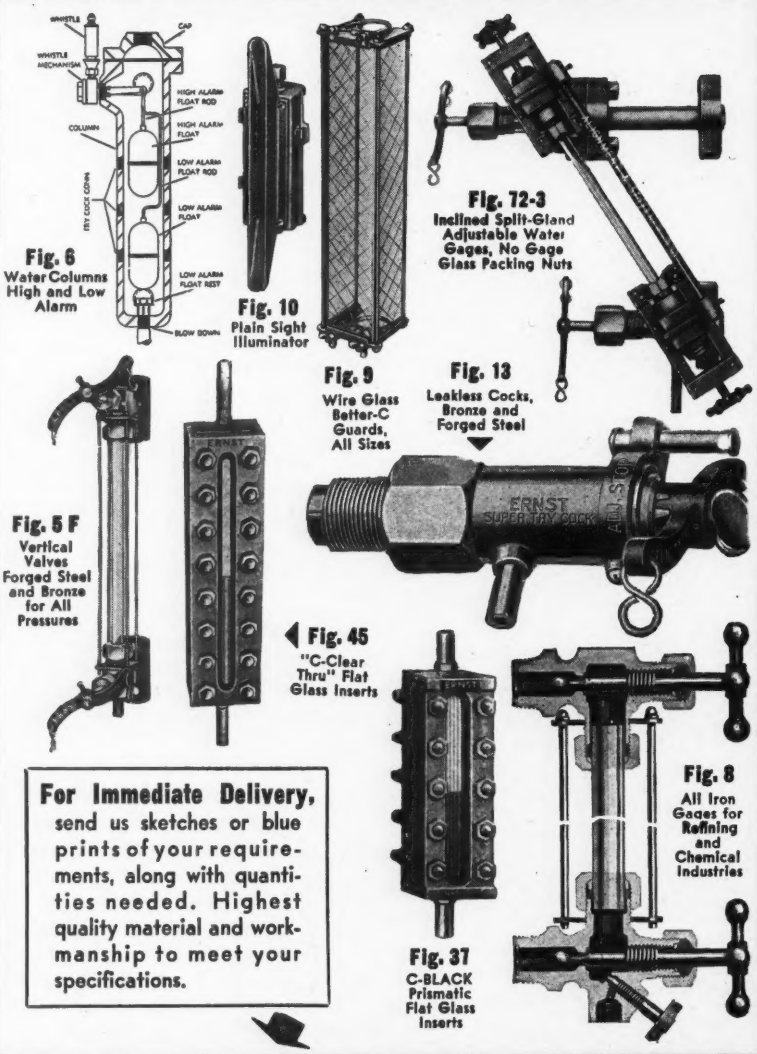
Fig. 6
Water Columns High and Low Alarm
Fig. 10
Plain Sight Illuminator
Fig. 9
Wire Glass Better-C Guards, All Sizes
Fig. 72-3
Inclined Split-Gland Adjustable Water Gages, No Gage Glass Packing Nuts
Fig. 13
Leakless Cocks, Bronze and Forged Steel
Fig. 5 F
Vertical Valves Forged Steel and Bronze for All Pressures
Fig. 45
"C-Clear Thru" Flat Glass Inserts
Fig. 8
All Iron Gages for Refining and Chemical Industries
Fig. 37
C-BLACK Prismatic Flat Glass Inserts

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CHANGE OF ADDRESS

To avoid missing an issue or paying for forwarding postage be sure to send a change of address to our office. Changes received by the 20th of the month can be made effective for following month's issue.

James A. O'Neil

JAMES A. O'NEIL, for 30 yr. leading designing engineer for the General Electric Co.'s lighting engineering department at the Lynn River Works, died November 5. He was 57 yr. old.

Mr. O'Neil was the holder of 20 patents covering important developments in the lighting industry. His last patent covered the stepped reflector of the Form 79 luminaire that passes the light flux by the lamp stem rather than through it. In 1941 he received a Modern Plastics award for the development of the plastic radial-wave reflector.

NEW ENGINEERING BOOKS

Mathematics for Electricians and Radiomen. By Nelson M. Cooke. First edition, 604 p. Size 6 by 9 in., cloth bound. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y. 1942. Price $4.00.

Practical men, mechanics and electricians alike, often find that their greatest obstacle to further advancement or to outstanding achievement in their work is a lack of understanding of mathematics. Skilled as they may be in the use of tools and in their understanding of methods and processes, without the skill to apply fundamental mathematical principles, they will be seriously handicapped in applying their knowledge to full advantage. Mathematics is a tool without which they are quite helpless.

This book was written to be of help to such men. It is a complete home-study text book that is so thorough, so careful and painstaking in its explanations, so detailed in its illustrative examples that any reader who can perform arithmetical computations rapidly and accurately is capable of mastering the principles laid down in this text.

It teaches elementary algebra through quadratic equations, logarithms, trigonometry, plane vectors and elementary vector algebra with direct applications to electrical and radio problems. The author is Chief Radio Electrician in the U. S. Navy and though the book comes out of the U. S. Navy Radio Material School at Anacostia Station, the slant which it has towards radio need in no way detract from the book's value to those not primarily interested in radio. The book grew out of the author's more than 8 yr. experience in teaching mathematics to U. S. Navy electricians and radio operators. It assumes only a knowledge of arithmetic on the part of the reader.

In many ways this is one of the best books on mathematics for home-study that we have ever seen. The author proceeds in logical manner, step by step from the simple to the complex and no principle is ever stated until the groundwork for a complete understanding of that principle has been completely laid.

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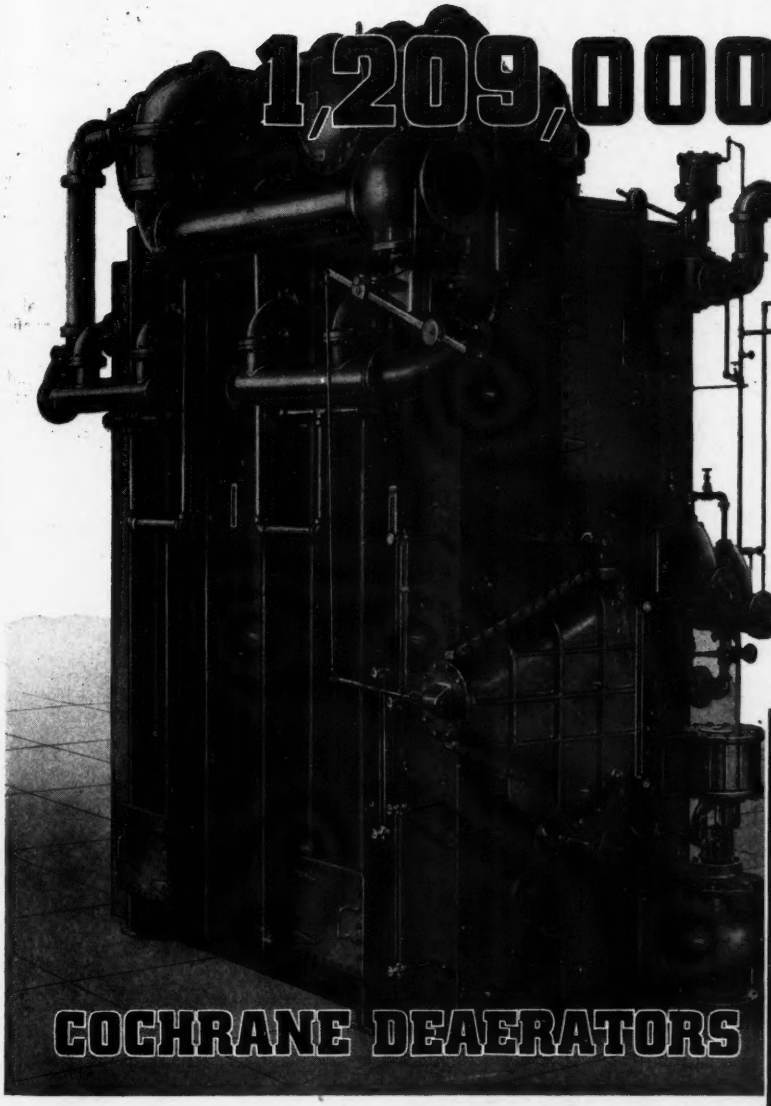

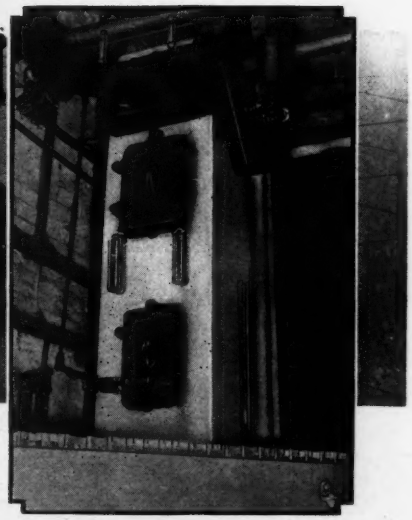

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The deaerators shown here illustrate the wide range of Cochrane water conditioning equipment. The larger deaerator is installed in one of the country's finest public utilities and represents the fifth to be installed in fifteen years. The smaller deaerator is installed in one of the South's largest textile mills and is one of five installed over a period of eight years.

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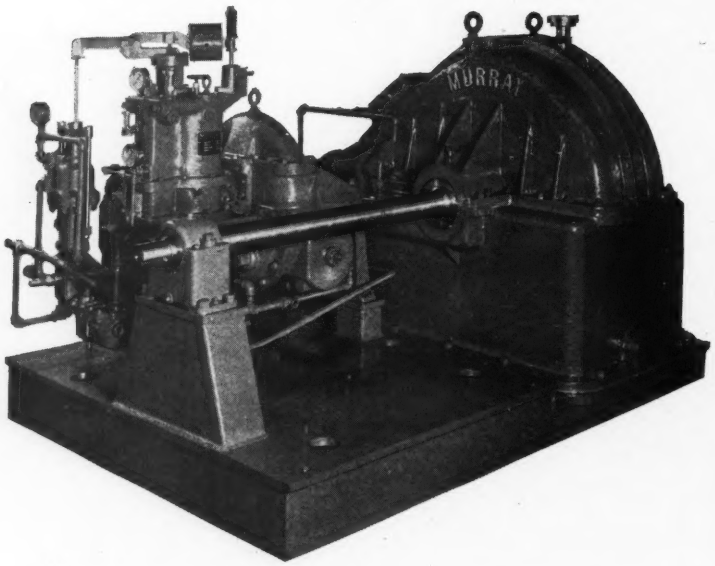
give war industries adequate and dependable power facilities



EACH MURRAY Turbine shipped from this organization is consigned to a war plant. That is our production schedule for the duration. Our entire facilities are devoted to meeting high priority needs.

Even though you may not have a rating that entitles you to purchase a MURRAY Turbine now, it will pay you to investigate. Find out the advantages MURRAY design and construction offer. When the time comes that restrictions in deliveries are lifted, you will have an answer all ready for your turbine needs.

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It Tells How . . . Where . . . Why . . .

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Reading the advertising messages that appear in POWER PLANT ENGINEERING is a profitable practice. It helps keep you posted on newest types of power equipment; tells how and where and why it can improve operating efficiency, conserve manpower, simplify maintenance.

One chapter has been devoted to the powers of ten in order to show the reader how to perform computations conveniently when using both large and small numbers encountered in the average electrical or radio problem. This is a method used by most engineers but not so generally found in mathematics texts. The two chapters on logarithms and their applications also are probably more complete than the treatment of this subject in other books.

In short, this is a most excellent book and we have no hesitancy in recommending it very highly, especially to those who have not had the benefit of formal training in mathematics.

National Paint Dictionary. 2nd Edition. By Jeffrey R. Stewart. Size 9 by 12 in., 224 p.; heavy fabricoid binding. Published by Stewart Research Laboratory, 1340 New York Ave., N. W., Washington, D. C. Price $7.50.

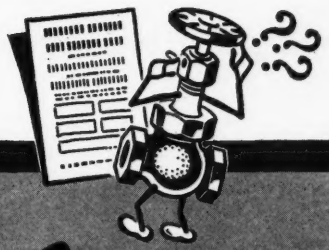
This new, completely revised second edition of the National Paint Dictionary is the most complete work of its kind available. It is a handy reference volume for chemists, production managers, purchasing agents, technologists and all who are engaged either directly or indirectly in the manufacture, distribution, use or application of paint and allied products. The book contains definitions of trade names of raw materials used in the industry, along with pertinent information regarding the names of chemicals, methods of analysis, and equipment and apparatus used in the paint and allied industries. The book contains many charts, tables and other useful information and miscellaneous data which can be used for ready reference.

This is a strictly technical work, arranged in a concise and comprehensive manner, and the definitions given are exact, reliable and universally accepted.

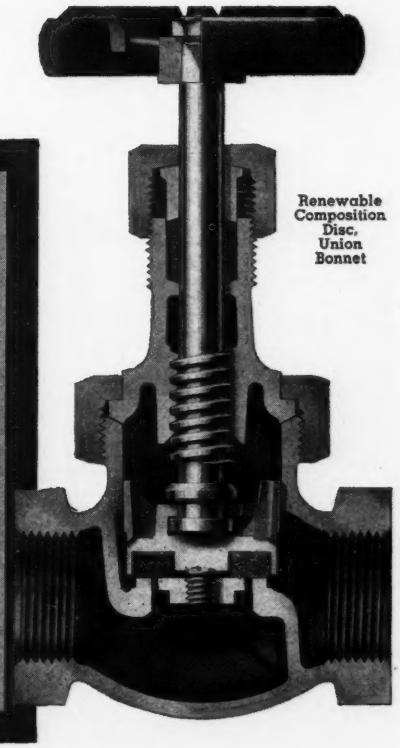
New Technical and Commercial Dictionary. Compiled by Antonio Perol Guerrero. Size 9 by 6 in., 600 p., semi-flexible fabricoid binding. Published by The Chemical Publishing Co., Inc., 234 King St., Brooklyn, N. Y., 1942. Price $10.

Because of the increasing interests of United States business in Pan-American countries, which has exerted a tremendous influence on the Spanish language, the author in this Spanish-English dictionary has attempted to set up a standard of terminology for all technical and commercial words in order to assist the engineer, the importer, the technician as well as the soldier. In many cases where there are no corresponding Spanish words, English words have been adopted bodily for most technical terms.

The dictionary contains 50,000 technical and commercial words used in electrical, mechanical, chemical and marine engineering, radio, mining, textile and other industries, and modern words pertaining to mechanized and motorized warfare, aviation, meteorology, etc. The book is divided into three parts: Part I, Spanish-English; Part II, English-Spanish; Part III, Conversion Tables of Weights, Measures and Monetary Units. The author is Industrial Engineer, Escuela



An Occupational Questionnaire for GLOBE VALVES



Renewable Composition Disc, Union Bonnet

Today, when it is more important than ever before to keep pipe lines flowing at maximum efficiency, too much care cannot be given to selecting the right valve for each job. Before you "draft" a valve for that all-important line, make sure it is the type you really need. Here are some hints on GLOBE VALVE selection which may help.

WHEN SHOULD GLOBE VALVES BE USED? Globe and angle valves are preferable to gate valves where the valve is to be operated frequently, because they open with fewer turns; and also where the valve is to be operated partially open, as on throttling service. They are not suitable where complete drainage of the pipe must be provided.

WHAT ARE THE ADVANTAGES OF ANGLE VALVES? Because of the basic similarity in operating mechanism, angle valves and globe valves are generally classed together. The use of angle valves saves an elbow and nipple and also reduces the pressure loss.

WHEN SHOULD COMPOSITION DISCS BE SPECIFIED? Globe and angle valves with composition discs are suitable for services other than high temperature. While these discs do not last as long as metal ones on throttling service, they increase the life of the seat by taking most of the wear of wire drawing, and are easier and cheaper to renew.

FOR WHAT SERVICES ARE METAL DISCS PREFERABLE? Metal discs in globe and angle valves last longer than composition discs on throttling and high temperature service.

WHEN SHOULD PLUG-TYPE DISCS BE USED? Globe and angle valves with plug-type discs are the best valves for throttling service.

WHAT ARE THE ADVANTAGES OF UNION BONNETS? Union bonnets are desirable when valves may require frequent repair or replacement of disc. This type of connection minimizes the danger of distorting the body or bonnet when reassembling the valve after repairing.

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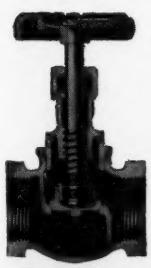
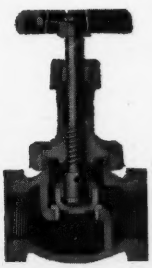
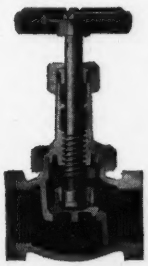


Bronze Disc, Screwed Bonnet



Full-way Disc, Union Bonnet Renewable Seat Ring



Regrinding Disc, Union Bonnet

Plug-type Disc, Union Bonnet Renewable Seat Ring

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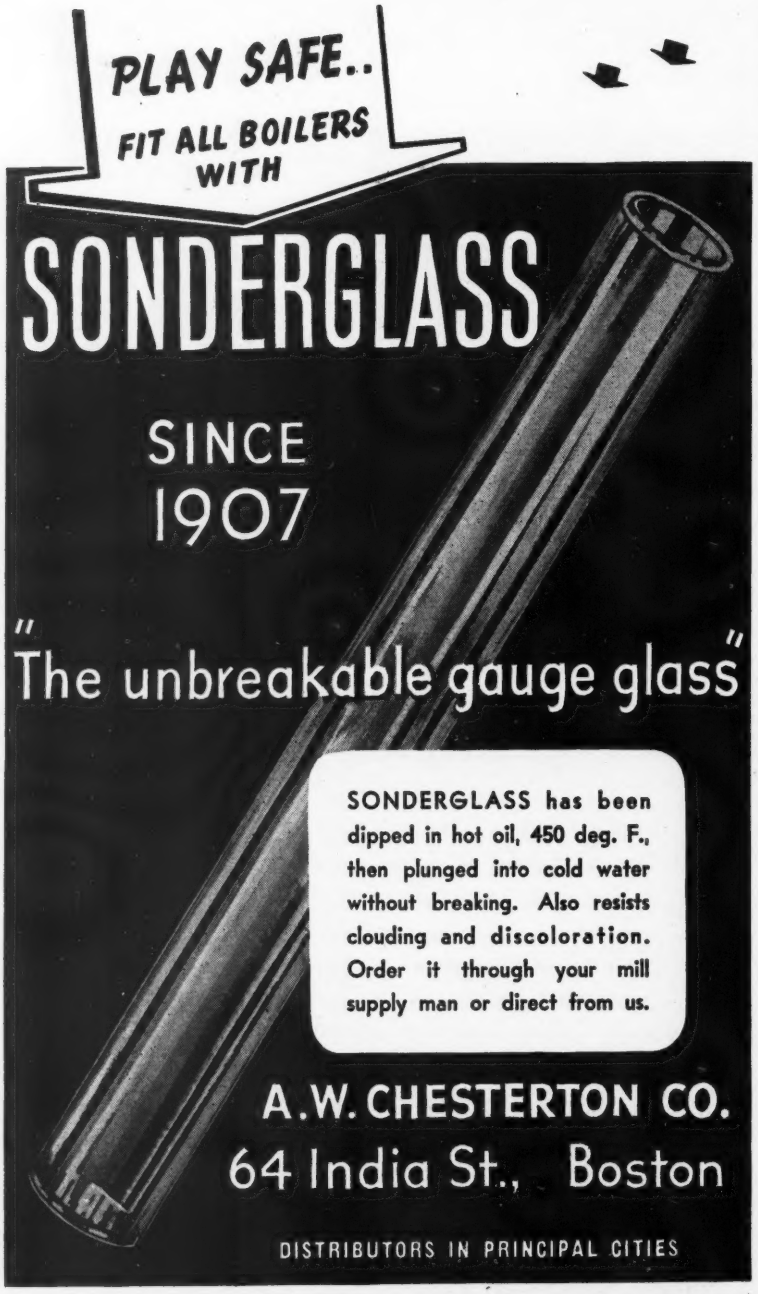
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Central de Ingenieros, Madrid, and Chief Editor of Editorial Tecnica Unida.

While a dictionary of this kind is without doubt of considerable value to those having intimate business and technical relations with the Pan-American countries, it must not be assumed that Spanish is the key to making ourselves understood throughout South America. Of the 90 odd million people in South America, over 40 per cent are in Brazil alone and the language of that country is Portuguese, and Spanish is of very little help in making ourselves understood by those speaking Carmen Miranda's language. This implies no criticism of the dictionary, which seems to have been well compiled and as far as Spanish and English are concerned, meets many valuable needs.

The 1942 Revenue Act. Size 7 by 9 in., 62 p., paper bound. Published by Research Institute of America, Inc., 292 Madison Ave., New York, N. Y. Price $2.

This is a clear and comprehensive analysis of the 1942 Revenue Act. Income tax, the new Victory Tax, excess profit tax, capital stock tax, other miscellaneous taxes, and a list of the many refund opportunities which the new Act has opened up are covered in detail. The size of the 1942 tax bill is such that it requires a thorough study of its many and complex features on the part of all business which hopes to survive the present upheaval, and this booklet will aid business, as well as individuals, in computing and filing tax returns so as to avoid mistakes and penalties.

This analysis is one of a continuing series which the Institute is issuing in an effort to keep the American public informed on all new developments in government of vital concern to all. Never before has it been so important for the taxpayer to avoid tax pitfalls and the new Revenue Act requires close study on the part of everyone required to file a return.

A.S.T.M. Standards on Coal and Coke. Prepared by Committee D-5 on Coal and Coke. Size 6 by 9 in., 130 p., paper bound. Published by the American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa., 1942. Price $1.35.

This pamphlet brings together in convenient form the various A.S.T.M. methods of testing, definitions, and specifications for coal and coke, and the standard specifications for the classification of coal according to rank and grade, requirements for gas and coking coals and specifications for sieves for testing purposes. The methods which are coming into widespread use cover coal sampling procedure and methods of test for grindability, sieve analysis, aggultinating value, drop shatter test, an index of dustiness of coal and coke and other corresponding tests for coke with additional tests for volume of cell space. In this field definitions are important and there are three such standards.

Mechanical Drawing. By Ervin Kenison, James McKinney and Tom C. Plumridge. 5½ by 8½ in., 330 p., cloth binding. Published by American Technical Society, Drexel Ave., at 58th St., Chicago, Ill. Price $2.

This is a practical how-to-do-it book, developed for the use of extension students as well as for home

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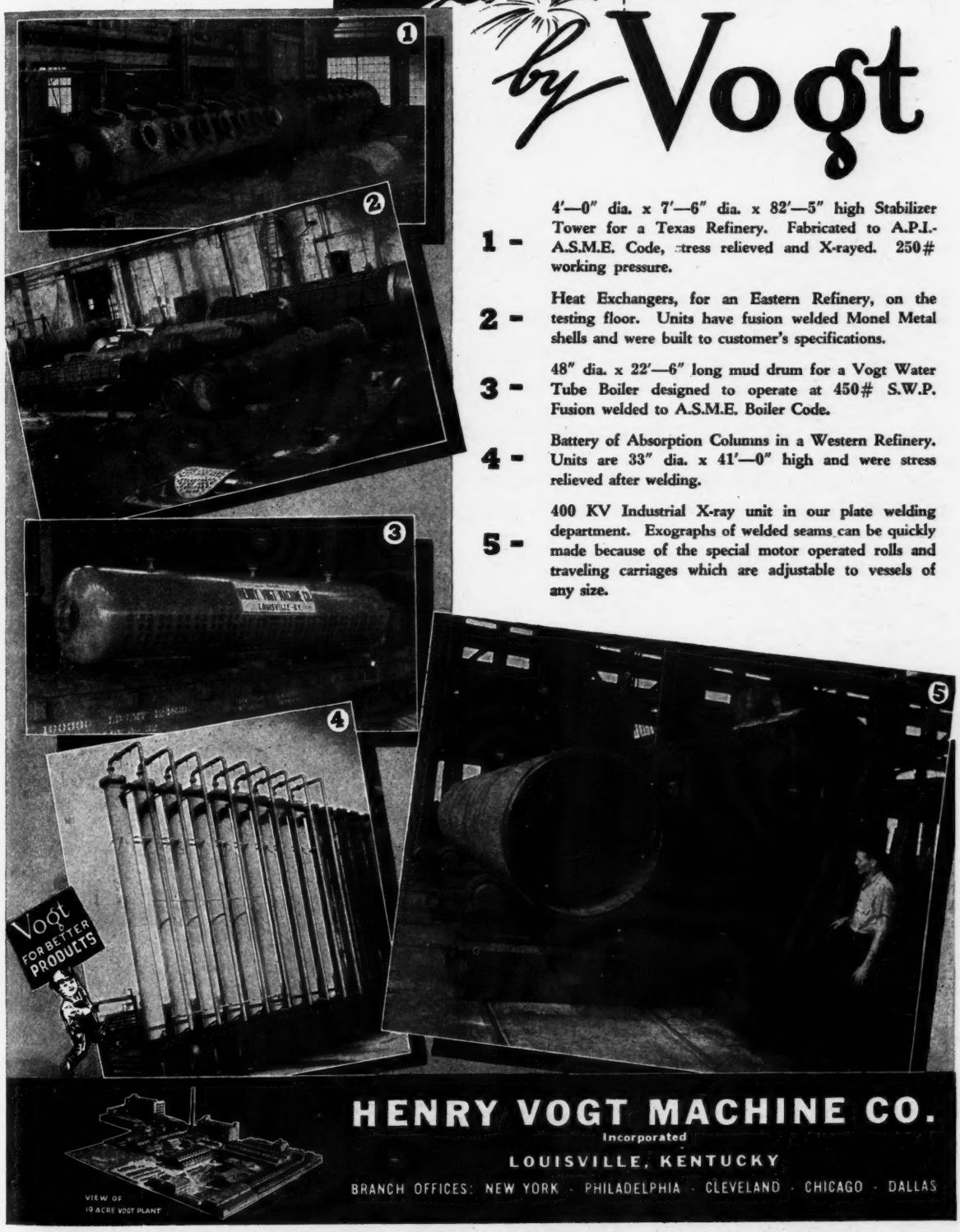

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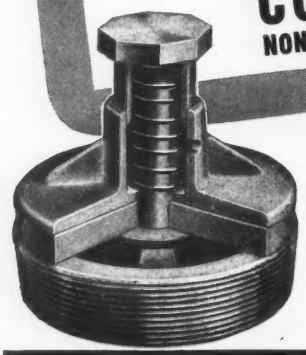

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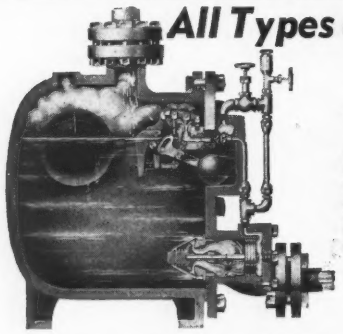

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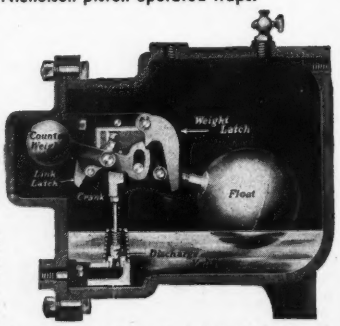

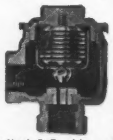

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study, high school, vocational school, trade school and evening school classrooms. The book covers the skills and technical knowledge needed in the specialized field of drawing. It contains a certain amount of drill work in the use of the instruments used in mechanical drawing and shows how to become adept in making neat and accurate drawings.

The book is divided into 14 sections covering instruments and materials, lettering, geometrical definitions and problems, symbols and conventions, working drawing principles, projection, hidden parts, sections and drawing to scale, working drawings and rules of projection, intersections, developments and isometric and oblique projection. At the end of each section are problems and exercises and there are 402 pen and ink drawings in the book.

The Specific Heats of Certain Gases Over Wide Ranges of Pressures and Temperatures. By Frank O. Ellenwood, Nicholas Kulik and Norman R. Gay. Published as Bulletin No. 30 of the Cornell University Engineering Experiment Station. Size 8½ by 11 in.; 22 p.; paper bound. Published by The College of Engineering, Cornell University, Ithaca, N. Y. Single copies free of charge; additional copies 50 ct. each.

This bulletin gives the general equations which determine the effect of pressure on the specific heats of gases, within ranges of temperature and pressure encountered most frequently in engineering practice. The gases considered in this paper are air, CO, CO_2, CH_4, C_2H_4, H_3, N_2, and O_2; the temperature range is from 0 to 4000 deg. F. and the pressure range is from 0 to 10,000 psi. Variations of specific heats with temperature and pressure are shown graphically.

Revised Code of Minimum Requirements for Instruction of Welding Operators. Copyright 1942, 68 p., paper covered. Published by the American Welding Society, 33 W. 39th St., New York, N. Y. Price 50 ct.

This booklet covers requirements for equipment, instructors, courses and tests with forms for student progress chart and record card. Instruction is for welds on material 3/16 to ¾ in. thick.

Engineering Mechanics, Second Edition. By Frank L. Brown. 6 by 9 in., 500 p., cloth. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price $4.

In this second edition the changes are largely in details of presentation and in illustrative problems. New type and cuts are used. This is a textbook for students of engineering, covering Statics in Part I; and Kinematics and Kinetics in Part II.

Derivation of formulas and equations by logic and by mathematical analysis, algebra and calculus being freely used. General principles of statics are discussed and factors which enter, including force, weight, resultant forces, couples, friction, graphic solution for coplanar forces, truss stresses, cable suspension.

In Part II on motion and forces, velocity, acceleration, inertia, angular velocity, relative and absolute motion, work, energy, power and momentum are treated. Full use is also made

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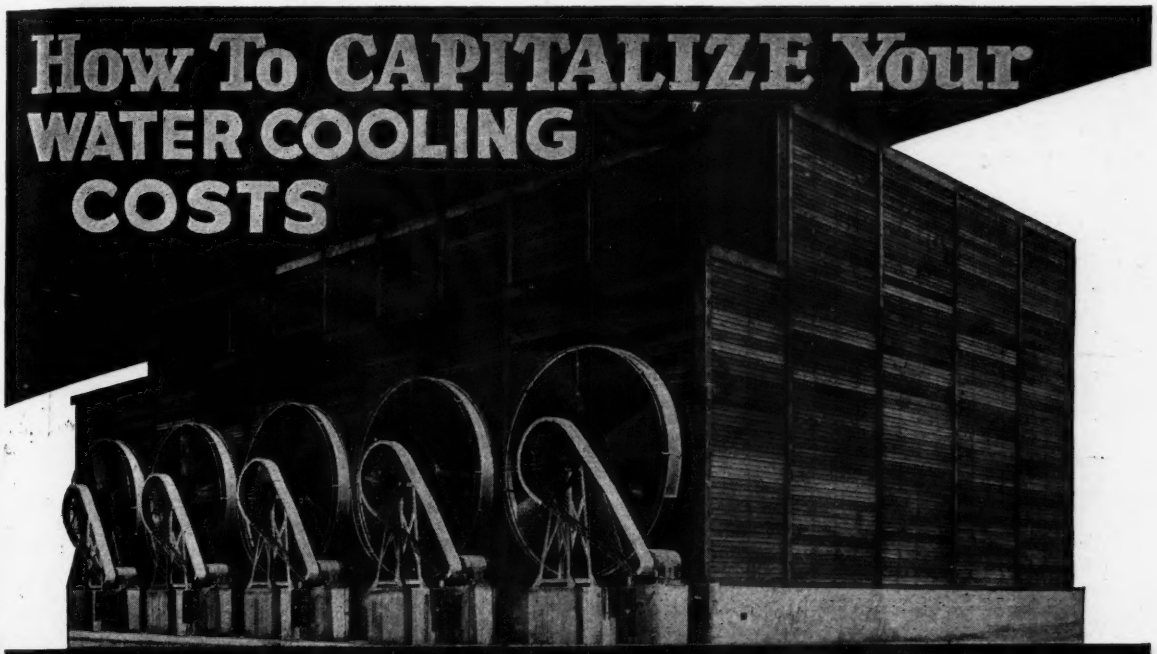

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Illustrative problems to be worked out by the student are liberally used, with answers given where it seems desirable.

The book is obviously intended for class-room work under direction of an instructor and should be satisfactory for that use as method of presentation has been studied to reduce time required in the class room for discussion and explanation.

Plant Engineer's Manual. By E. Molloy. Size 5 by 7½ in., 231 p., cloth bound. Published by Chemical Publishing Co., Inc., 234 King St., Brooklyn, N. Y. Price $3.

This little book is a handy collection of practical data and information for the engineer responsible for the operation and maintenance of equipment, both mechanical and electrical, in the industrial power plant. It was written in England and while in some cases reference is made to equipment used in that country, for the greater part the data presented is as applicable in this country as it is in England.

The book is divided into four sections with the following headings: Sources of Power; The Transmission of Power; Plant and Equipment; and Efficiency in Works and Factories.

Electric Motors in Industry. By D. R. Shoults and C. J. Rife. First edition. 389 p., 6 by 9 in. cloth. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price $4.

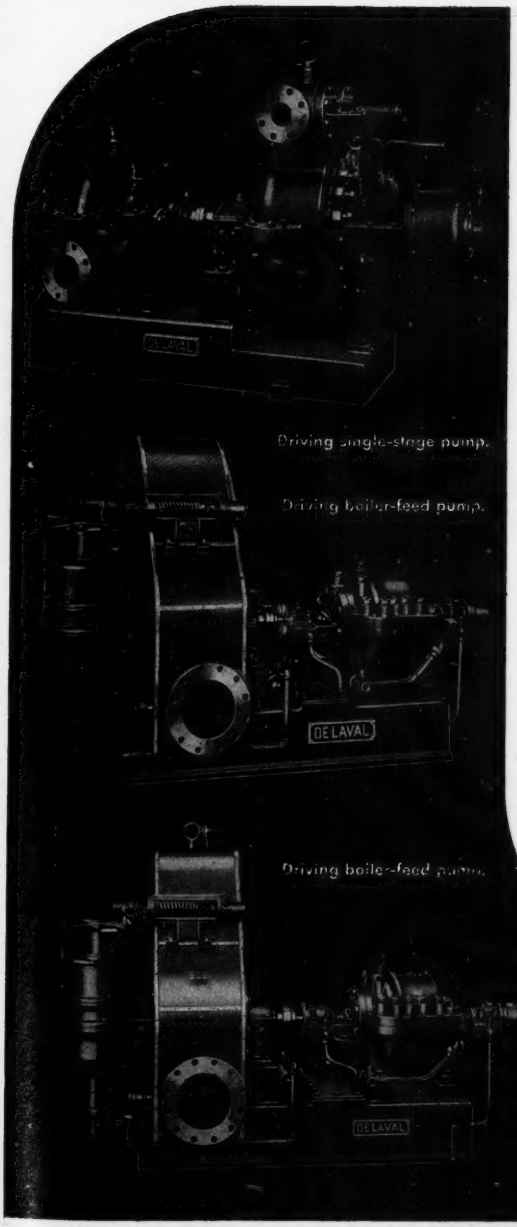
This is one of a series of books written in the interest of the advanced engineering courses of the General Electric Co. It deals with the characteristics of motors and their control.

While written for industrial engineers the material has also proved useful to engineering students for it emphasizes a point of view which augments and strengthens the more detailed methods of analysis.

As pointed out by the authors in the preface, the importance of engineering in the world today is axiomatic, and the increasing use of power in all its forms has made tremendous demands on engineering technique and personnel. More than ever before, clear thinking is necessary especially when dealing with engineering. Since one man can never hope to know everything it is more and more important that each engineer should have a clear understanding of the basic principles. This book deals with those principles of motor applications which are readily understood, and which at the same time form the best basis for correct application.

The material given includes the salient facts of motor operation, omitting all detailed analysis not essential to understanding this operation. Clarity of presentation has been sought by emphasizing the so-called "physical picture" which gives a sense of proportion and fitness. For example, an induction motor is thought of in terms of a slipping clutch rather than in terms of an equivalent circuit or complicated equation. Likewise, a synchronous motor may be visualized for many purposes as two groups of rotating magnets, one of which drags the other around. This method of presentation should appeal to the

10 Advantages of DE LAVAL Velocity-stage TURBINES for Driving Auxiliaries



1 Most reliable; independent of electrical transmission line, generator and switchboard disturbances.

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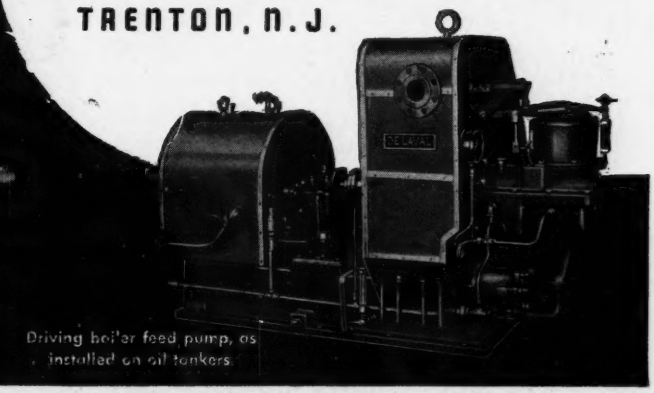

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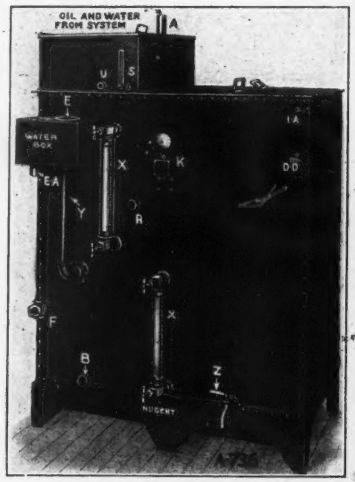

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practical man, the man who has to select and operate motors but who may not be very good in mathematics.

The book is the outgrowth of a course in industrial engineering given by the General Electric Co. for its engineers in training for positions in engineering departments, laboratories, and sales organizations of the company and the industry generally to convey a clear and sound knowledge of motor performance. It is a book which we have no hesitation in recommending in the highest possible terms.

Electrical Circuits and Machinery. Vol. II, Alternating Currents. By Frederick W. Hehre and George T. Harness. First edition. 635 p., 6 by 9 in., cloth. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price $6.

This book is intended by the authors, both as a general textbook for non-electrical engineering students and as an introductory textbook for electrical engineering students, but its range of interest is, of course, by no means limited to these two groups. It should be of interest and value to engineers in the field as well.

This volume deals with alternating current circuits, Volume I with direct current circuits. The first six chapters treat the electrical circuit, with a suitable emphasis on the polyphase circuit. As indicated in the preface, it has been the authors' experience that many students fail to grasp the relationships in the 3-phase circuit. A large part of this difficulty arises from the failure to establish clearly the elementary ideas of voltage and current representation as rotating vectors. Unless the basic ideas are firmly established, it is impossible to develop logically the relations of the 3-phase circuit. In this book considerable time is spent in the development of these ideas and their extension to permit a logical calculation of all polyphase relations.

Two chapters developing the complex or symbolic method of representing voltages and currents, one dealing with the single-phase circuit, the second with the polyphase circuit, are introduced. These chapters may be omitted without loss of continuity.

The discussion of machinery is introduced with the transformer and conforms to current engineering practice. New methods of construction, such as strip-wound transformer cores, are discussed along with the theoretical and practical reasons of their use. Although empirical and more advanced methods of analysis of alternator behavior are introduced, the emphasis is on simpler methods which are more easily understood and lead to reasonable results.

The two chapters on electronic devices, in conjunction with the chapter on electronics in Volume I, form a complete analysis of the theory and application of such devices to all except specialized communication practice.

All considered, this is an excellent book, of value to the student and experienced engineer alike.

American Electricians' Handbook. 5th Edition. By Terrell Croft. Revised by Clifford C. Carr. Size 5 by 7½ in., 1600 p., 1177 illustrations, 64 tables; semi-flexible fabricoid binding. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y. Price $5.

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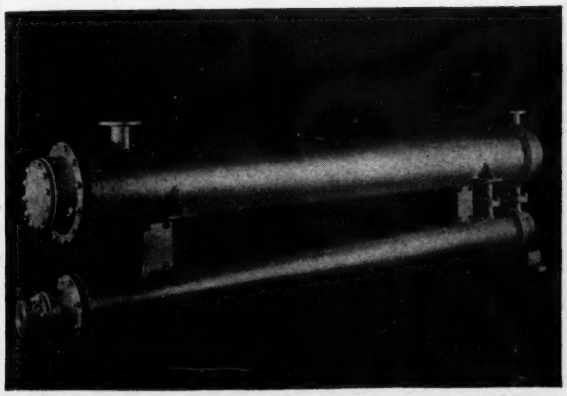

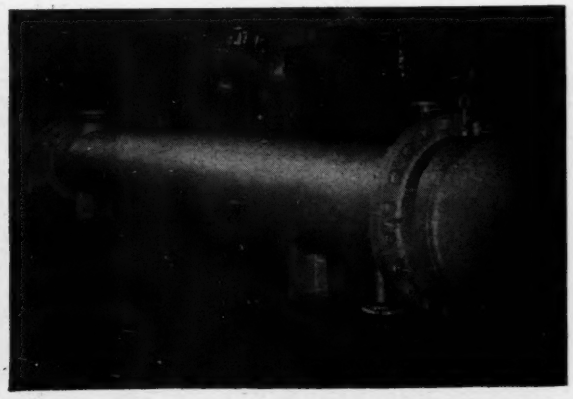

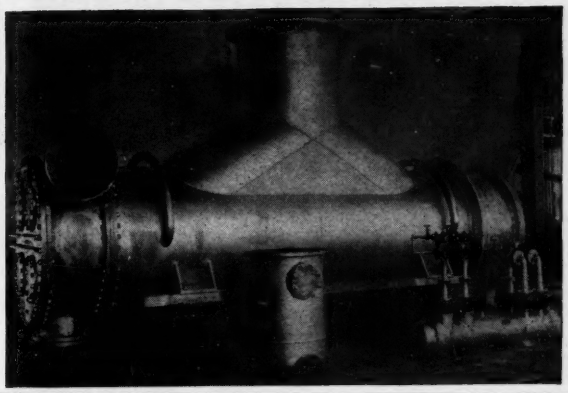

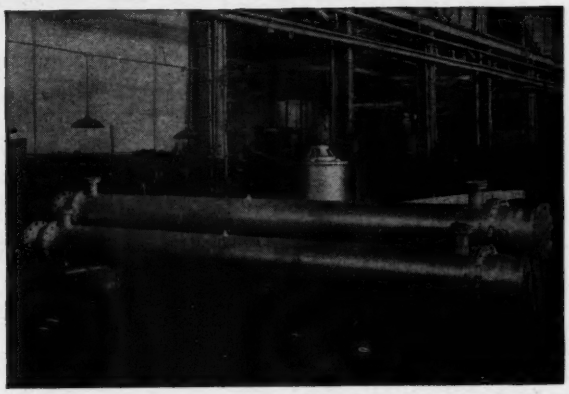

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MULTIPLE SPREADER STOKERS

BURN COAL LIKE OIL!

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I wish to take this opportunity of congratulating you upon the excellent stoker which you have furnished us. We have used your stoker continually for about six weeks, namely, during the time we were putting up our pea pack. This is the time of the year when the greatest stress is put upon men and machinery and I must say that your stoker came through with flying colors.

Never before have we had such even steam pressure and such a maximum amount of driving power. Your FYR-FEEDER burns up the coal most uniformly, thereby getting the utmost heat out of the fuel, and leaving very little waste.

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ACT now to protect yourself against *FUEL SHORTAGE, steam shortage and manpower shortage.* **WRITE or WIRE today.**

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MULTIPLE SCREW FEEDERS 12" APART
TWO FIRES FINES BURN IN SUSPENSION. LARGER COAL ON GRATE.
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UNDER GRATE AIR

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AMERICAN COAL BURNER CO.

ENGINEERS, Est. 1918

22-18 East Erie St., Chicago, Ill.

The new fifth edition of this popular handbook has been revised and expanded in order to be in accordance with latest good practice and the 1940 National Electrical Code. Many parts are completely rewritten and there are more than 600 pages of new material. Four new divisions are included, making a total of ten divisions in the book. One entire new section is devoted to an extensive treatment of the properties and splicing of conductors; another is devoted to circuits and circuit calculations; and the third to general electrical equipment and batteries. The fourth new division is a compilation of wiring tables so that the information which is most frequently required in planning electrical installations is in a form most convenient for use.

This book should be in the hands of all the hundreds of thousands of people now engaged in electrical work of all kinds. It covers all the principal branches of electrical work with which the electrician will come in contact throughout his career. It will enable the practical man to develop into a more skilled craftsman; it will save him time and trouble on difficult assignments; it will help him progress faster, thus earning more money and winning recognition in the field as one who knows his business. During this time when America is engaged in an all-out war production program, the information in this book is vitally essential to those who are helping in this all important effort.

The book gives a clear explanation of the fundamentals of practical electricity as well as practical suggestions for remedying the troubles encountered in electrical equipment. It presents the kind of information useful to wiremen, contractors, linemen, plant superintendents, operators, construction engineers, etc., in selecting, installing and operating commercial electrical apparatus and materials for every service.

The titles of the ten divisions of the book are: Fundamentals; Properties and Splicing of Conductors; Circuit and Circuit Calculations; General Electrical Equipment and Batteries; Generators and Motors; Transformers; Outside Distribution; Interior Wiring; Electric Lighting; and Wiring Tables.

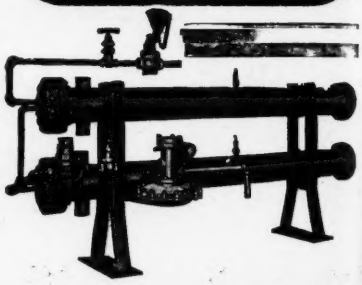
Heat Transmission. By William H. McAdams. Second edition, 450 p., 6 by 9 in., cloth. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y. Price $4.50.

Designed as a text book for students and a reference for practicing engineers, this book presents the principles of heat transmission as necessary to the understanding of specific problems. Data has been gathered from diverse sources and correlated for analysis and reduction to working formulas.

Under the divisions Conduction, Radiation and Convection are treated thermal conductivities, effect of shapes, heating and cooling of solids, radiation from solids and flames, furnace design, coefficients of heat transfer, effects of scale, counterflow, multipass and cross-flow action, forced and free convection of fluids.

In the revision, material not easily available has been sought out to show the progress in heat transfer engineering and the result from modern experimental methods of laboratory study and methods of computation.

HENSZEY



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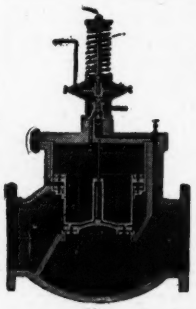

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This valve installed in the upstream line automatically maintains a uniform water level within 3" to 12" variation to prevent any tank overflow; also, by means of the internal "stop check" piston assembly, prevents loss or return of storage water back through the valve—making the valve very desirable for use where metered water is purchased, or wherever it is imperative that there be no possible return flow.

This valve may be fitted with "Differential" Control for delayed opening, if desired.

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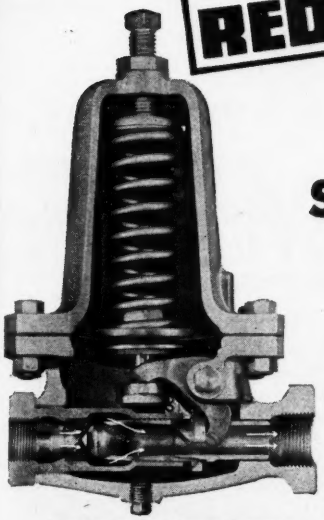
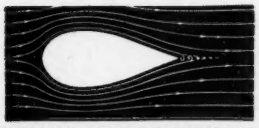
LOST PRODUCTION HOURS DUE TO "TIME OUT" FOR VALVE TROUBLES . . .

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE **REDUCING VALVE**





HERE'S THE "1000" FLOW PATTERN
The Streamlined form of the inner valve eliminates turbulence. It produces the flow pattern shown above which makes for maximum capacity when it is needed most and permits accurate pressure control under toughest working conditions.

You can find out full details on all of the Type 1000 benefits by reading Bulletin "1000" —send for it!

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Today, with speed in output the keynote of American Industry, trouble-free, smooth performance of equipment is essential to maintain schedules. Keeping idle hours down to the very minimum is a vital need in any type of production.

Because of these very things, the CASH STANDARD Streamlined Type 1000 Reducing Valve has a place of importance in industry's fast-operating set-up . . . it is an immediate answer to the practical elimination of "time-out" periods.

When this valve was first designed, 'round-the-clock service — month in and month out was the objective. How well the Streamlined Type 1000 fits into the pace-setting production picture now is seen by its no-trouble, maintenance-free operation for years past.

Among the benefits users get with it are: maximum capacity when needed most — accurate pressure control under toughest working conditions — elimination of failures — cost-saving operation.

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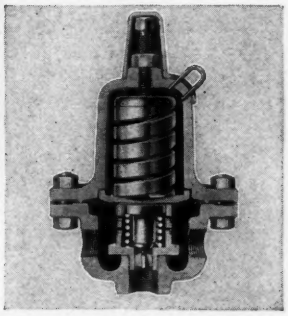
Answer: **"Yes Sir; we do! And we propose to picture one or two of them here each time."**



Cash Standard Type Q Relief Valve; maintains constant upstream pressure by relieving into lower downstream pressures, regardless of variations in downstream pressure. For steam, water, air, oil, many gases. (Similar valve for refrigeration fluids.)

Iron or bronze bodies; bronze trim; pressures up to 350 lbs.; top temperature 500° F. Screwed ends; sizes ¼" to 2".

Cash Standard Type 4190 Valve; holds constant back pressure on inlet side regardless of variation in outlet pressure or changes in load. A multiport, large capacity valve. Used on suction line in refrigeration practice. Also used extensively as bypass valve for oil pumps.

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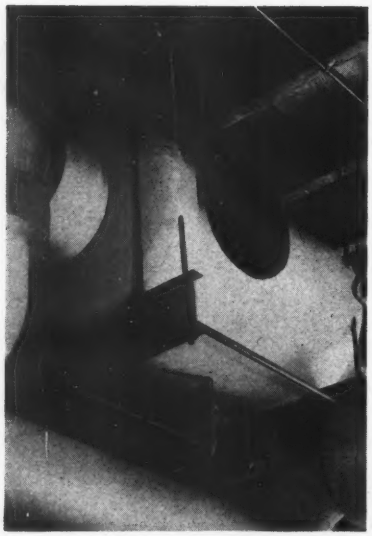

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- by removing dirt and moisture from steam.
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Methods of correlating data for effective use in design are shown with use of graphical charts.

This is a thoroughly scientific and comprehensive treatment but is highly technical and uses somewhat involved mathematical methods of analysis. It is therefore for the use of those well grounded in calculus and for them the treatment is detailed, definite and informative.

In Chapter XI on Applications to Design are considered determination of best thickness of insulation, types cost and operation of various constructions of heat exchanging apparatus, baffles, tube arrangements, vents and drains, best flow velocities and best amount of water for condensers and coolers.

In the Appendix are assembled tables for the thermal conductivities of metals and of insulating materials; emissivity of various surfaces; specific heats; viscosities; dimensions of iron pipe and of condenser tubes.

Manual for Committees of Engineers Interested in Engineering Education and the Engineering Profession. Size 6 by 9 in.; 15 p.; paper cover. Published by the Engineers' Council for Professional Development, 29 West 39th St., New York, N. Y., with a separately-bound Appendix A addressed to the student as a prospective engineer. Copies of the Manual with Appendix A may be obtained from Council headquarters at 10 ct. a single copy; copies of Appendix A alone, 5 ct. a single copy. Discount on quantity orders.

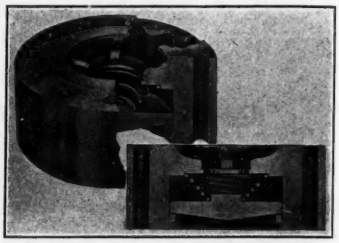
This guidance manual outlines a general procedure recommended to individuals or groups in the engineering profession for presenting to high school students the aims and essentials of engineering education, the aptitudes required, and the types of civilian and armed forces needing engineers. It presents material on the organization and selection of these committees representing local sections of national societies or local engineering clubs and societies and points out the necessity of cooperating with vocational guidance programs already established in secondary schools and with other local and professional groups interested in the problem of helping young people select their career or life work.

Appendix A is designed for use by the student in supplying biographical and educational background and should be reviewed by the advisory committee or counselor prior to a conference with the candidate.

Power Switchgear Assemblies Standards. Size 8 by 10½ in.; 65 p.; paper cover. Published as Publication No. 42-72 by the National Electrical Manufacturers Association, 155 E. 44th St., New York, N. Y. Price $3.25.

This is a revision of the Power Switchboard Standards published in 1937. The new standards cover assemblies of switchgear devices such as switches, interrupting devices, control, metering, protective and regulating equipment with associated interconnections and supporting structures. General manufacturing and application standards applying to switchgear devices, standards for indoor metal-clad switchgear, removable truck switchgear, indoor cubicle switchgear, outdoor switch houses, enclosed low voltage air circuit breaker switchgear up to 600 v. a.c. and 750 v. d.c., and auto-

WILLIAMS-HAGER
Flanged Silent Check Valve



- Non-Wear Conical Spring
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- Works In Any Position
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These improved side-guided check valves stay tight under every condition of service and pressure. Easily installed between flanges and readily removed for inspection. Sizes up to 20 in. and for pressures to 6,000 lb. They will handle all liquids, hot or cold—water, oil, gasoline, chemicals, etc. Get further details about this economical protection for pumps and service lines.

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rotary displacement pump, directly connected to a motor running at 1450 r. p. m., delivers oil against a pressure of 330 lbs. per sq. in. to the lubricating system of the vertical thrust bearing of a large hydraulic turbine. The pump end is submerged in the oil sump. There are no valves, no gears and no pump bearings. The flow is without pulsation, as from a steadily advancing piston. Ask for Catalog I-94.
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Get the top price for your Monel and rolled Nickel scrap

Segregate and avoid contamination

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Every pound you turn in is of real and immediate aid. And every such pound of scrap that is not contaminated with other metals, that is free of oil and dirt and properly segregated will return a higher price per pound to you.

When sent with proper authority direct to the Huntington Works of The International Nickel Company, Monel and rolled Nickel scrap is remelted into the form of pig. This is used, by the steel industry, in the making of important alloy steels.

Remember your effort in this scrap drive is not only a fine contribution to victory, it can pay you a substantial cash dividend.

The table and notes at right will help you in the sorting and identification of scrap metals.

QUALITATIVE TESTS FOR IDENTIFYING SOME COMMON WHITE METALS AND ALLOYS

MAGNETIC TEST	NITRIC ACID TEST				
Reaction to Magnet	Reaction to Conc. Acid	Reaction to Acid after Dilution	Color of the Solution	Iron Nail Test for Copper	Material Probably is
Magnetic	Reacts Slowly	Reacts Slowly	Pale Green	No Copper Plates out	Rolled Nickel
Magnetic* (slightly)	Reacts	Reacts Slowly	Greenish Blue	Copper Plates out	Monel
Non-magnetic	Reacts	Reacts	Bluish Green	Copper Plates out	Copper-Nickel Alloy containing less than 60% Nickel, e.g. Nickel-Silver
Magnetic	Reacts Slowly	Reacts	Brown to Black	Not required	Steel or Cast Iron
Non-magnetic	Reacts Slowly	Reacts	Brown to Black	Not required	Ni-Resist
Magnetic	No Reaction	No Reaction	Colorless	Not required	Straight Chromium Stainless Steel
Non-magnetic	No Reaction	No Reaction	Colorless	Not required	Chromium-Nickel Stainless Steels e.g. "18-8"

*Monel is usually but not always slightly magnetic at atmospheric temperature. Monel that appears to be non-magnetic at atmospheric temperature may become magnetic when cooled by dipping in ice water or in a freezing mixture—other copper-nickel alloys of lower nickel content do not become magnetic. Monel that is magnetic at atmospheric temperature loses its magnetism when heated by dipping in boiling water. This test serves to identify Monel when only a magnet is available—no other common material loses its magnetism in this temperature range.

†"K" Monel is always non-magnetic even when cooled; therefore chemical analysis is required to distinguish "K" Monel from the copper-nickel alloys of lower nickel content.

NOTES ON CARRYING OUT TESTS

1. Magnetic Tests

Bring the magnet in contact with the specimen to be tested. (Be sure that there is no magnetic material such as iron or steel beneath or in the immediate vicinity of the specimen.) The magnet will or will not be attracted to the specimen.

In cases of doubt, and especially where the material appears to be non-magnetic, use a more sensitive testing method:

(a) Balance the magnet or the specimen on the edge of a bench or desk. Then bring the specimen close to the magnet, or vice versa. If the material is magnetic the balance will be upset and a movement of either the magnet or the specimen will be observed.

(b) Another method is to suspend the magnet on a string and bring it close to the specimen. A slight movement of the magnet will be observed if the specimen is even slightly magnetic.

2. Nitric Acid Tests

Clean test surface so that the acid will come into direct contact with the material.

Apply one or two drops of concentrated nitric acid to the clean metal surface.

Let acid remain in contact with the metal for a minute or two.

Observe any reaction that takes place.

Dilute acid by adding three or four drops of water, one drop at a time.

Observe reaction: If solution turns green or blue do not disturb until nail test has been completed.

3. Copper Test with Iron Nail

If nitric acid test forms green or blue colored solution, make test for copper:

Rub a clean iron nail in the colored acid solution on metal surface, keeping nail in contact with the specimen.

If the alloy contains copper, there will be a deposition of copper either on the nail or on the surface of the metal under the acid solution.

Add a drop or two of additional water as the nail is rubbed around to prevent the deposited copper from re-dissolving in the acid.

IMPORTANT!

No Monel and rolled Nickel scrap should be sent to Huntington without authorization.

Authorization must be obtained from the Scrap Salvage Section, Monel and Rolled Nickel Sales Department, The International Nickel Company, Inc., 67 Wall Street, New York, N. Y.

Letters requesting authorization should state:

1. Kind of metal (Monel or Rolled Nickel)

2. The amount

3. Type of scrap—turnings, forgings, castings, strip, sheet, etc.

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67 Wall Street **New York, N. Y.**

"Every dime and dollar not vitally needed for absolute necessities should go into WAR BONDS and STAMPS to add to the striking power of our armed forces."
—*President Roosevelt*

EVERYBODY EVERY PAYDAY 10%

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That means we must raise our sights all along the line, with every firm offering every American with a regular income the chance to buy more *War Bonds.* YOUR help is asked in encouraging employees to put at least 10 percent of their pay into War Bonds every payday, through the Payroll Savings Plan.

For details of the Plan, approved by organized labor, write, wire, or phone Treasury Department, Section T, 709 12th St. N. W., Washington, D. C.

U.S. WAR SAVINGS BONDS

This space contributed to America's All-Out War Program by

POWER PLANT ENGINEERING

matic switchgear are covered in the book, together with definitions, graphical symbols and information on standard equipment.

Transformer Standards. Eighth Edition. Size 8 by 10½ in.; 69 p.; paper cover. Published as Publication No. 42-73 by the National Electrical Manufacturers Association, 155 E. 44th St., New York, N. Y. Price $3.

This revised standard is divided into four sections. The first section is devoted to general standards dealing with the principles on which temperature limits are based in the rating of electrical machinery and apparatus. The other sections cover transformer ratings, performance and manufacturing standards and information on lead markings and connections for constant potential transformers. Standards for single-phase pole type distribution transformers are included together with definitions and a comprehensive index.

Enclosed Switch Standards. Size 8 by 10½ in.; 19 p.; paper cover. Published as Publication No. 42-78 by the National Electrical Manufacturers Association, 155 E. 44th St., New York, N. Y. Price 60 ct.

This new standard includes general, performance, rating and marking standards for air break switches having their current carrying parts enclosed in metal cases and enclosed switches with or without provision for plug or cartridge enclosed fuses. The section devoted to general standards covers switch types, enclosures and enclosure specifications, operating mechanisms and spacings, wiring space and terminals. The section on performance standards includes temperature limitations, overloads, endurance and dielectric strength tests. The part on ratings deals with voltage, current and horsepower ratings of fusible enclosed switches.

Arc Welding Job Training Units. Prepared by the Staff of Dunwoody Industrial Institute. Size 8½ by 11 in., 103 p.; spiral-bound paper cover. Published by American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Price $1.25.

Gas Welding Job Training Units. Prepared by the Staff of Dunwoody Industrial Institute. Size 8½ by 11 in., 92 p.; spiral-bound paper cover. Published by American Technical Society. Price $1.25.

These two books are part of the Dunwoody Series on Machine Shop Training. The one on Arc Welding consists of 40 jobs with an information sheet and a sheet of checkup questions on the first 32 jobs. A job information sheet is furnished with the last eight jobs. The book on Gas Welding consists of 40 jobs with a job information sheet and checkup question sheet for the first 28 jobs and a job information sheet for the last 12 jobs.

Both of these plans of training and training materials have been tested on the job in industry and in schools and are adaptable to the needs of all schools and all people interested in electric and gas welding.

Each book contains several pages of suggestions and helps on the use of the Manuals and an Instructor's Guide in the use of the books has been prepared and is available for 75 ct.

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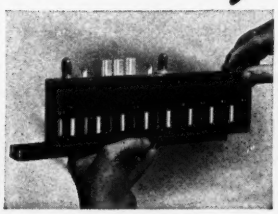

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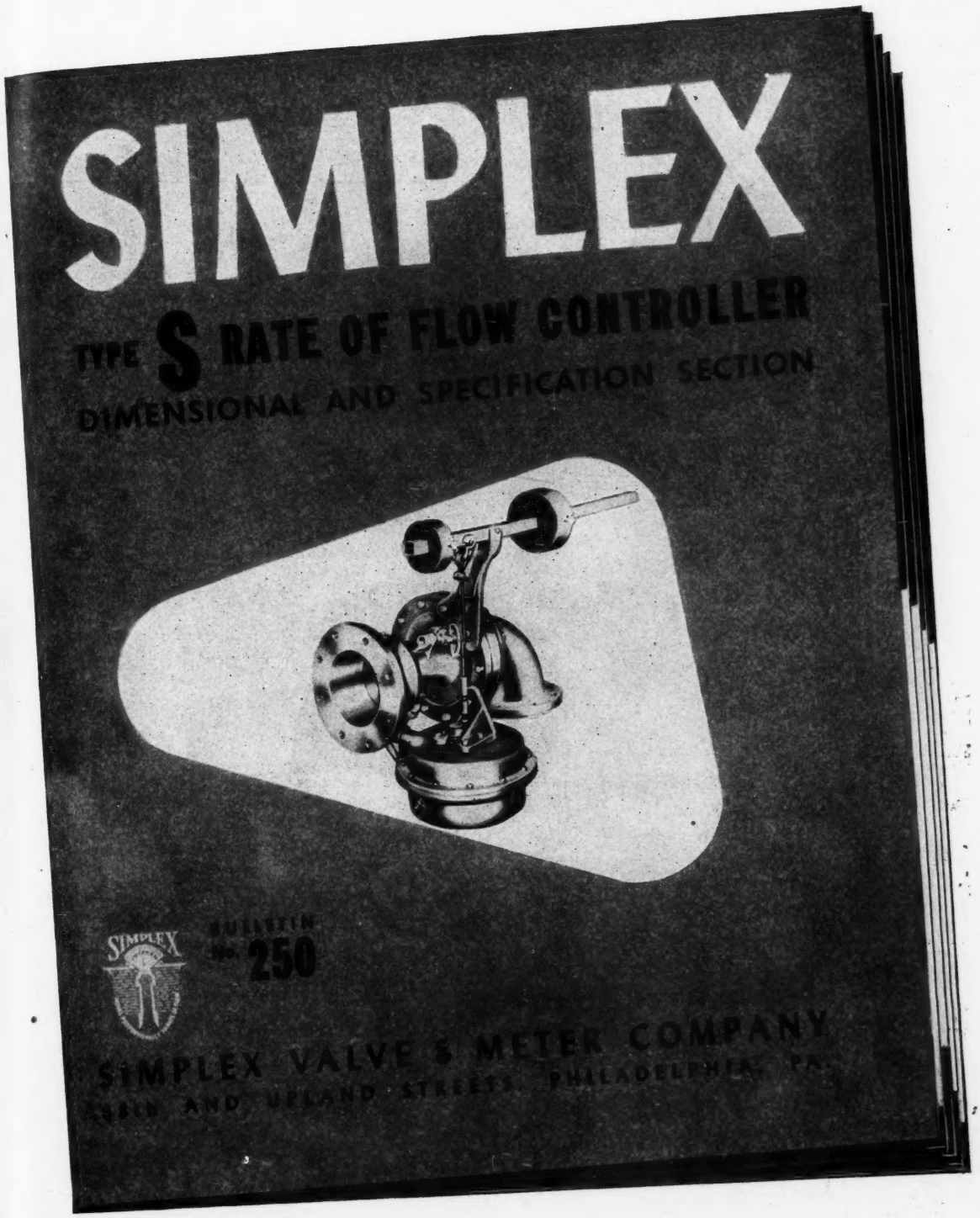

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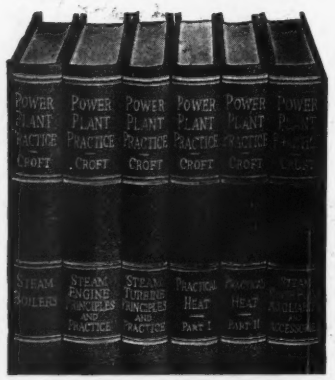

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Electrical Equipment

1 Unit Substations—Master Unit Substations for incoming voltages from 13,200 to 132,000 and outgoing voltages from 2500 to 13,800 are illustrated and described in Bulletin GEA-3800. Included in the bulletin are photographs of actual installations, tables of specifications and tables of weights and dimensions. General Electric Co.

2 Switchgear—Switchgear Bulletin B-6185 is a complete review of all types of modern switchgear now going into wartime power plant construction. Included are descriptions and illustrations of all indoor and outdoor type switchgear, with removable circuit breakers or fixed breakers with special attention given to the latest developments in switchgear, including the air-blast circuit breakers and switchgear as a part of the new factory-assembled unit substations. Allis-Chalmers Mfg. Co.

3 Switchboards—Revised Bulletin No. 3000 describes circuit breaker and fusible switchboards. Typical installations are illustrated and tables of capacities and dimensions are included. Square D Co.

4 Electric Drills—The Drill Use Book, designed to show new workers, especially in war industry plants, the correct methods of using portable electric drills and obtaining greatest efficiency and longest life from these important war production tools, has recently been issued. The booklet covers: assembling the drill, the switch control, drill chucks and bits, how to use the drill, and several points on user maintenance and care. The Black & Decker Mfg. Co.

5 Field Rheostats—Pressed steel rheostats with rectangular and round contacts are illustrated and described in Bulletin 69 and Vitrohm and Ribohm field rheostats are covered in Bulletin 60A. Both bulletins are well illustrated and contain tables of dimensions, lists of accessories and spare parts, and price lists. Ward Leonard Electric Co.

6 Recorders and Indicators—Micromax Frequency Recorders and Indicators for use in central stations and industrial power plants are illustrated and described in 20-p. Catalog N-57-161. Leeds & Northrup Co.

7 Valve Operator—Catalog A4 lists applications, design features and functional data of the Type 2 Valve Operator. Included in the catalog are diagrams and tables of dimensions and general specifications. Automatic Temperature Control Co., Inc.

Pumps and Compressors

8 Pumps—Catalog DS-1042 covers the new Type SCV Pump for clear liquid service in capacities from 10 to 500 g.p.m. The catalog contains photographs, line drawings, tables of dimensions and selection tables. Economy Pumps, Inc.

9 Centrifugal Compressors—Design 9 centrifugal compressors are described in Catalog No. 386-2. Included are illustrations of installations, cross-section views of the compressor, tables of ratings and dimensions, and a performance curve. B. F. Sturtevant Co.

10 Marine Rotary Pumps—Marine rotary pumps, both power and hand-operated, are covered in Bulletin No. 120. The bulletin gives mechanical design features and illustrates various types of pumps available. Blackmer Pump Co.

JOHN MORRELL & CO.

S-T-R-E-T-C-H-E-S COAL DOLLARS

Through Better Sizing The "AMERICAN" Way

BY passing their incoming coal through a 24-30 AMERICAN Ring Crusher, John Morrell & Co., at Ottumwa, Iowa, makes sure of more nearly perfect sizing. And more uniform sizing, of course, means a higher and more constant CO_2, reduces the carbon content of the ash, makes coal dollars buy more steam.

The money-saving experience of this busy packing plant is being duplicated in scores of industrial plants and central stations where AMERICAN Crushers—used in either stoker or pulverized coal burning—are reducing total fuel costs from 2½ to 8%.

AMERICAN Rolling Ring Crushers differ from other centrifugal crushers in that their housings are heavy steel castings, reinforced with ribs making them unbreakable from any crushing strain. Material to be crushed is struck by rings in suspension which shatter and distribute the coal before it reaches the breaker and grinding plate. By a simple adjustment of the patented grinding plate (made of manganese steel to insure long wear) run-of-mine or lump size is reduced to proper size in one operation.

24-30 American Ring Crusher at John Morrell & Co. plant. It handles 50 t.p.h. bituminous coal 6 in. feed, reducing to ½ in. and under for pulverized fuel use

SPLITS THE COAL

One of the patented shredder rings of the American Crusher—an exclusive feature that splits the coal to uniform size and prevents clogging

AMERICAN Ring Crushers have capacities of 10 to 500 tons per hour, are built special for each installation and guaranteed for definite performance. Let AMERICAN Crusher engineers co-operate in getting better coal sizing and lower steam costs in your plant.

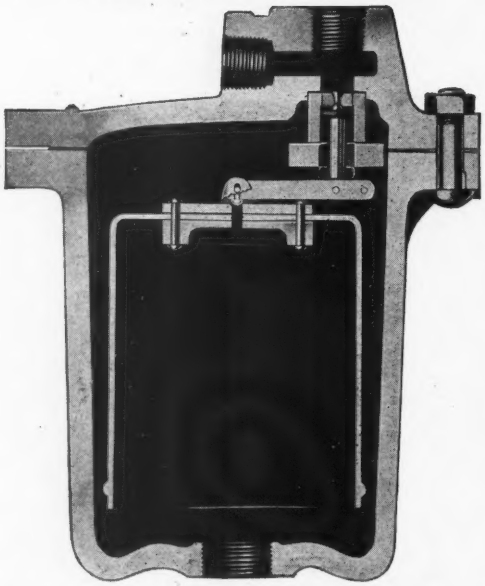
AMERICAN PULVERIZER COMPANY 1429 Macklind Avenue St. Louis, Missouri

ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

PIPEWRENCH PETE SAYS:

Here's Why STRONG Inverted Bucket Traps DON'T BALANCE!

Exclusive "Trigger" Vent Gives Sharp, Intermittent Action



Saves on Production, Steam, Upkeep!

Now, STRONG gives you inverted bucket traps with an exclusive "trigger" action vent that ends balancing once and for all!

Full, intermittent operation, plus Anum-Metl seats and discs, plus wearproof parts permit us to guarantee STRONG traps a full year against leakage or wear.

Write for your copy of catalog 63-PE12 today!

Here's The STRONG "Trigger" Vent!

While bucket floats, valve almost closes vent. As bucket fills and reaches point of discharge, it starts to sink, removing valve from vent. This allows large quantity of air to escape suddenly, and causes bucket to sink to the bottom. Assures full, intermittent action.

Strong, Carlisle & Hammond Company
1392 West Third St., Cleveland, O.

STRONG
STEAM SPECIALTIES

Water Treatment

11 **Mixing Tanks**—Form 312 is a 4-p. bulletin which illustrates and describes chemical mixing tanks and proportioning equipment. Included are photographs and cross-section drawings with tables of standard sizes of mixing tanks and types of meters recommended for use with chemical proportioners. Graver Tank & Mfg. Co., Inc.

12 **Water Filters**—Pressure-type water filters are illustrated and described in a new bulletin, Form 313, recently issued. Included are photographs of typical installations, line drawings and tables of specifications. Graver Tank & Mfg. Co., Inc.

13 **Feedwater Conditioning**—Conditioning Feedwater for High-Pressure Boilers is the title of Reprint No. 23 by Austin C. Dresher which is a resumé of the art of feedwater conditioning written in plain language, easily followed and understood by operating engineers. The article discusses the requirements for high-pressure boilers and modern feedwater conditioning equipment is described. Cochrane Corp.

Piping and Fittings

14 **Clamp Ring Joints**—Alco clamp ring joints for use on heat exchangers and similar equipment for all working pressures and temperatures found in process operation, are covered in Bulletin 1032. Included are cross-sectional drawings and photographs of the various joints available. Alco Products Div., American Locomotive Works.

15 **Plumbing Brass Goods**—A complete line of ground key brass goods, including stops and stop and drains, ferrules, nipples, unions, etc., are illustrated and sizes and services given in Catalog Section 1-A. Hays Mfg. Co.

16 **Steel Tubing**—Electric resistance welded rail carbon steel tubing is illustrated and described in a new 25-p. catalog. Included are photographs showing the process of making the tubing, lists of applications and tables of standard sizes and gages. Steel and Tubes Div., Republic Steel Corp.

Tools and Accessories

17 **Production Tools**—A new 15-p. bulletin covers special tools and tool attachments which are finding wide use in war production plants. Covered in the bulletin are attachments used in the manufacturing and repair of airplanes, airplane engines, shipbuilding and repair, installing ship machinery and for use in close corners and narrow spaces. Included are dimension charts for standard and special tools. Invincible Tool Co.

18 **Metal-Cutting Tools**—Stellite 98M2 Metal-Cutting Tools for Machining Steel is the title of a new 6-p. folder, Form 5783, which lists sizes and prices of 84 standard square and rectangular tool bits and 74 varieties of welded-tip tools made of 98M2, a non-ferrous cutting tool material. Included are recommendations for grinding wheels for use on tools made of this alloy. Haynes Stellite Co.

19 **Machine Tool Accessories**—A new 8-p. bulletin illustrates and describes a complete line of machine tool accessories, such as live centers, metal etchers, demagnetizers, grinding wheel dressers, etc. Machinery Products Div., Ideal Commutator Dresser Co.

Construction Materials and Methods

20 **Cement**—A 24-p. pamphlet entitled, Cement Dispersion and Air Entrainment in Concrete Pavement Construction, by Edward W. Scripture, Jr., Director of the Master Builders Research Laboratories, contains a detailed and partly technical account of the character development and use of HP-7, which is essentially a combination of an

Dust Takes a Holiday-

with a Thermix

Every engineer knows that one type of dust collector will not meet every requirement. That's why Thermix Dust Collectors are made in three types.

If your space is limited, you can install a Thermix Tubular Dust Collector in approximately the space required for a horizontal flue—or it can be built in connection with a vertical flue or directly beneath an air preheater.

If the greatest efficiency is required, then the Thermix Controlled Multicyclone is our recommendation.

But if you wish to combine your induced draft fan with your dust collector—or if you wish a dust collector which overcomes its own resistance, then the Thermix Recirculator is indicated.

There is a reason, therefore, for each of the three types of Thermix Dust Collectors.

Why not ask our Research Department to recommend the correct type. They will gladly do so without obligation. Write today for catalogs Nos. 105-107.

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84 So. Water St., Port Chester, N. Y.
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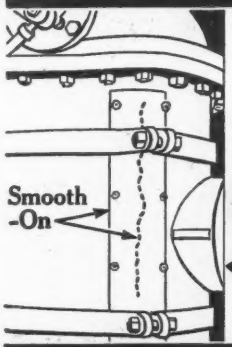
Manufacturers also of Thermix Induced Draft Stacks

THERMIX DUST COLLECTORS

CRACKED!



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"Saved from the scrap heap by SMOOTH-ON" is the story that could be told by many an engineer about one or more important pieces of equipment in his plant. Condensers, pumps, heaters, evaporators, engines, compressors, valves and process apparatus . . . wherever a crack occurs in the shell or casing of these and similar types of machines, a SMOOTH-ON repair is speedy, simple, effective, and lasting.

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air-incorporating agent with a cement-dispersing agent, and of other products intended for the same ends; and includes reports of tests on various ordinary and special concretes at 3, 7 and 28 days. Master Builders Co.

21 **Welding**—Weld Thin Metals is the title of Bulletin B-6049A which illustrates and describes the Weld-O-Tron, an instrument for welding thin metals. The bulletin includes illustrations of applications throughout industry, as well as for the armed forces, with special attention given to applications in the shipbuilding and aircraft industries. Allis-Chalmers Mfg. Co.

22 **Rolling Doors**—Rolling and sliding grilles, rigid and folding upward acting doors in wood and steel are described in a new 8-p. general catalog. Included is complete information and illustrations on recent designs which substitute wood for critical metals. The catalog also includes dimensions and specifications for the various types of doors. Cornell Iron Works, Inc.

23 **Bolts and Anchors**—Expansion bolts and anchors for highway, industrial and general use are illustrated and described in detail in Catalog No. 42. Included in the catalog are tables of sizes and list prices. American Expansion Bolt & Mfg. Co.

24 **Industrial Equipment**—Whiting Products for Industry is the title of Book No. 236 which covers the company's complete line of cranes, railroad and aviation equipment, cupolas and foundry equipment, quickwork products, Swenson evaporators and filters, and other special Whiting equipment for heavy industries. Whiting Corp.

Miscellaneous

25 **Drives**—Econ-O-Matic drives are illustrated and described in Catalog ED-42. The catalog describes both V-belt and flat-belt drives and gives data on motor base mountings for special applications. It includes blueprints, drive selection and dimension tables and photographs and case histories of typical power-transmission installations. American Pulley Co.

26 **Humidifiers**—Armstrong Humidifiers in Industry is the title of a new bulletin which describes the application of humidification in a wide variety of industries. Data is also included on the use of humidification for the control of dust, lint and static electricity. Armstrong Machine Works.

27 **Record System**—A new folder, entitled Case History No. 414, describes Microstat Microfilming, a photographic process of recording on miniature film any record that is written, typed, drawn or printed. Microstat Corp. of New York.

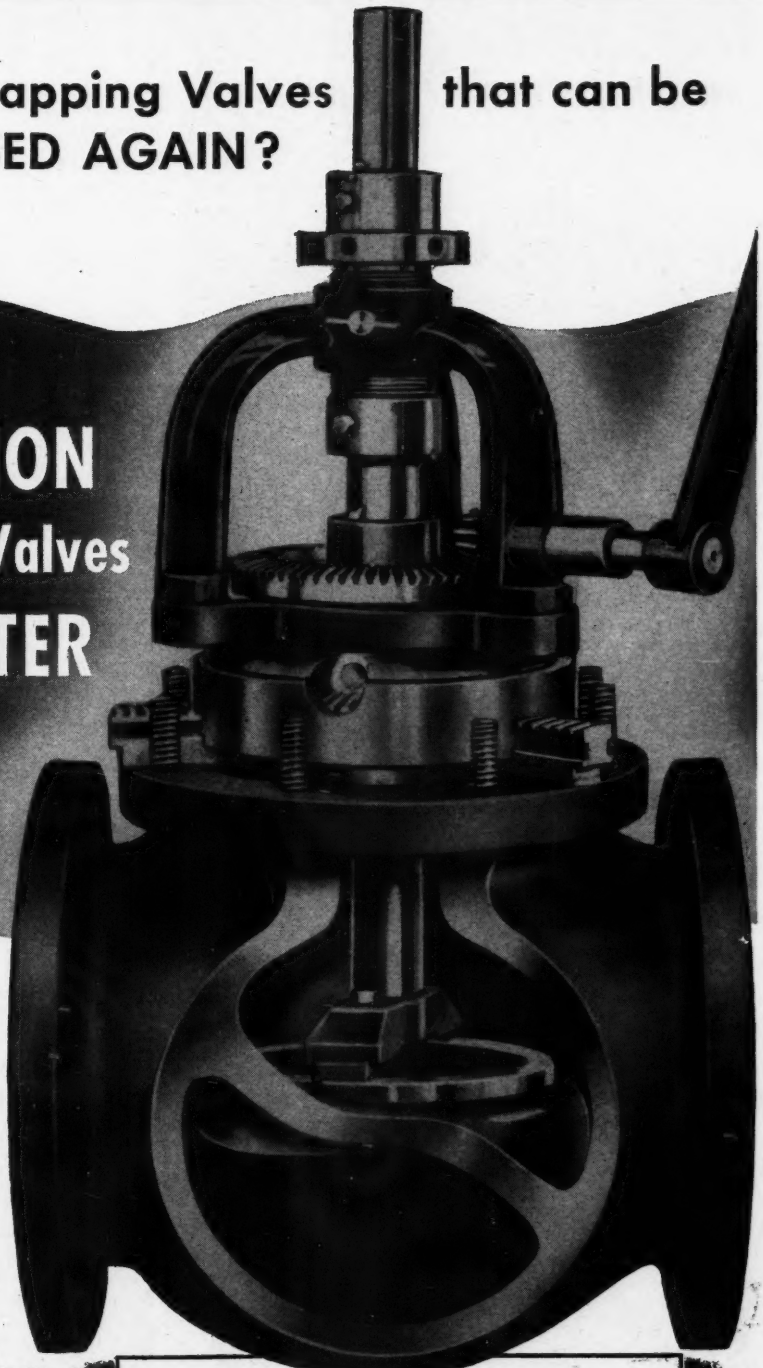
28 **Graphite Lubrication Handbook**—This 28-p. handbook is a guide to increased war production for plant engineers by the use of Cograph, a natural colloidal graphite. The handbook explains the work which graphite performs and lists the various products supplied. Included is an indexed list of machinery parts to which Cograph is applicable. Nassau Laboratories.

29 **Accident Prevention**—Two colored posters, G-362 and G-363 illustrate and stress the prevention of accidents in war production plants. American Mutual Liability Insurance Co.

30 **Wartime Maintenance Digest**—This is an 8-p. bulletin in convenient data sheet form describing how degreasing materials, descaling methods and related cleaning techniques save time, conserve man-power, and increase efficiency in handling 41 important equipment maintenance, plant housekeeping and sanitation jobs. The Digest outlines the material used, method followed, the time saved, fire or other hazards which are eliminated and other advantages gained which increase operating efficiency as well as secure greater output and longer service from Diesel engines, lubri-

Are You Scrapping Valves that can be USED AGAIN?

RECONDITION
Old and Leaky Valves
WITH DEXTER
Reseating Equipment



Even during these times, when new valves and parts are so hard to get, many company scrap piles contain valves which Dexter Valve Reseating Equipment can quickly *put back into good condition.*

And don't forget the proven value of Dexter Valve Reseating Equipment for keeping your working valves—*any* make or metal—in good condition *on the line.* Using Dexter Equipment, *any* mechanic can make all seats, gates or discs absolutely PRESSURE TIGHT again.

For more than *50 years,* Dexter Valve Reseating Equipment has been essential to industry. *Today,* because of the need to preserve valves and conserve power, Dexter Valve Reseating Equipment is absolutely *vital.* Write for further information today.

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THE LEAVITT MACHINE CO., 401 EAST RIVER ST., ORANGE, MASS.

DO YOU WANT TO SEE THIS—HERE IN AMERICA?

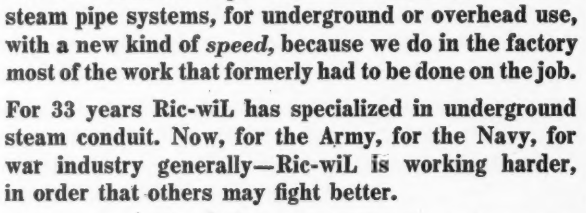
—then WORK or FIGHT!

OUR entire wartime program is designed to keep the war *away* from America. This plan, operating on far-flung battle lines, demands the utmost effort from every American. The command today is—work or fight!

In building up our vast system of men and armaments, Ric-wiL is proud to have a limited but vital part. To put more steam behind the war effort, steam supply lines themselves are needed, not by the foot but by the mile. Ric-wiL Insulated Pipe Units make available efficient steam pipe systems, for underground or overhead use, with a new kind of *speed*, because we do in the factory most of the work that formerly had to be done on the job.

For 33 years Ric-wiL has specialized in underground steam conduit. Now, for the Army, for the Navy, for war industry generally—Ric-wiL is working harder, in order that others may fight better.

For full information on complete Pre-Fabricated Insulated Pipe Units, as well as various other types of Ric-wiL Conduit Systems, write today for Catalog.



1—Steam pipe
2—Sectional pipe covering
3—Pipe support
4—Thick strip asphalt applied after welding
5—Asbestos felt over asphalt coated Hel-Cor
6—Air space
7—Butt welded connection

RIC-WIL INSULATED PIPE UNITS FOR UNDERGROUND STEAM LINES
THE RIC-WIL CO., CLEVELAND, OHIO
Agents in Principal Cities

cating oil and jacket-water coolers, feedwater and fuel oil heaters, surface condensers, transformers, compressors and other power plant equipment. Oakite Products, Inc.

31 **Degreasing Machines**—A 24-p. catalog in two colors illustrates and describes Detrex solvent degreasing equipment for metal cleaning. The catalog contains information on various types of degreasers available and gives data on solvents. Degreasers of special design and construction for cleaning in armament production are also included. Detroit Rex Products Co.

32 **Industrial Skin Creams**—Fend, a new line of industrial skin creams and lotions for barrier protection of workers' skin against industrial dermatitis, is described in a new 16-p. bulletin FA-79. Mine Safety Appliances Co.

Special Request Bulletins

Correspondence Courses. In American School Quarterly Bulletin are given full data in regard to complete training courses and annual scholarships covering high school subjects, liberal arts, commercial subjects, and all branches of mechanics and engineering. Many special courses have been developed in vocational training for war industries including aviation, shipbuilding and plastics. The work is carried on by home study, with diplomas awarded on completion of courses. American School, Drexel Ave. at 58th St., Chicago, Ill.

Technical Writing—A new correspondence course, designated as Specialized Exposition is being offered to technical and professional men as well as students in the technical fields to assist them in preparing articles for publication in the technical press and in writing business letters and reports. The course covers organization and arrangement of material, style, paragraphing, punctuation, proofreading and other requirements of editorial standards. University Extension Division, The University of Wisconsin.

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Bring your engineering equipment library up to date. Write in squares below with pencil the bulletin or catalog numbers you desire. Then detach and mail this coupon promptly.

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THERE IS NO EXCUSE
FOR BEING A *SCRAP SLACKER!*

Your country still needs scrap metal—in spite of all stories to the contrary. And you've got the kind that's needed most!

What are you doing about it? Are you making excuses and marking time? Or are you going ahead with a real scrap program in your plant—one that will get these dormant materials into the war in a hurry?

That's what you've *got* to do. Don't be content with simply selling your production scrap. Get out the idle and useless machinery, the old tools, dies, parts and fixtures. Tear down abandoned structures.

Read these questions and answers. They will give you the straight dope on the entire scrap problem. Read them even if you think you have already done a good job. Then go to work and really *scrap!*

1. Why this big fuss about scrap?

New steel is half pig iron and half scrap. We are making millions of tons more steel than ever before. Then too, in normal times a good percentage of all steel eventually finds its way back to the mills as scrap. But today, steel goes overseas as weapons—and none comes back.

2. Can't the mills use a smaller percentage of scrap?

It is possible to make steel of pig iron alone. *But* to make one ton of pig iron takes ½ ton of limestone, 1.2 tons of coal, and 2 tons of iron ore. It is impossible to mine and transport enough of all these to replace even a small percentage of scrap.

3. Why do some local scrap piles still stand?

The American people came through magnificently with household scrap. But it was quickly found that this light material must be mixed with large quantities of *heavy* scrap, such as you have. Without your help, this flimsy scrap cannot be used in quantity.

4. How can I decide what to scrap?

Apply the ruling given in the box to everything in your plant. Not only machinery, but every single piece of idle metal on the grounds!

5. How shall I go about it?

Form a Salvage Committee and put a Salvage Manager in charge. Select a high executive for this job—one who has the authority to make decisions and to buck unthinking opposition. Go over your plant with a fine-tooth comb, marking what is to go. Then see that it goes!

6. Suppose I've already done the job?

You haven't! No matter how well you've done, it's been proved you can turn up much more. This is a continuing job, just as it is a continuing need. Try again and you'll be amazed at the results.

7. Is scrap deductible from my income tax?

This is important. If the item you scrap still appears on your books, it can be deducted. If you have already fully depreciated it, it cannot. Consult your accountant or attorney.

8. What if the material is still usable?

Find a buyer for it. Your scrap dealer or a used machinery dealer will buy usable material and equipment at higher than scrap prices. This includes pipe, rails and the like, in good condition. Write to this magazine for help with this problem if necessary.

9. To whom shall I sell my scrap?

If you don't know of a scrap dealer, look in the classified phone book. Dealers are glad to get heavy industrial scrap. Sort it according to materials, and separate the usable items from the mass—you will get higher bids. If the tonnage is high, you might get competitive bids from more than one dealer.

10. Do I have to sell it to a scrap dealer?

Yes. No one else is set up to sort and process scrap. This is an unbelievably difficult task, as there are 75 recognized grades of steel alone. As to profits—of course he makes a profit. He is a businessman just like you, and like you, his prices are regulated by Government ceilings.

WHAT IS DORMANT SCRAP?

Obsolete machinery, tools, equipment, dies, jigs, fixtures, etc., which are incapable of current or immediate future use in the war production effort because they are broken, worn out, irreparable, dismantled or in need of unavailable parts necessary to practical re-employment.

FOLLOW THIS RULE

If it hasn't been used for three months, and if someone can't prove that it's going to be used in the next three — sell it — or scrap it!

• • •

Don't hang onto things simply because you may need them after the war. A lack of scrap can lose this fight—and then what good will you get from the stuff you have hoarded?

BUSINESS PRESS INDUSTRIAL SCRAP COMMITTEE

ROOM 3303, EMPIRE STATE BLDG., N. Y. C.

If you have done a successful salvage job at your plant, send details and pictures to this magazine.

SEND FOR THIS SCRAP MANUAL TO HELP YOU TACKLE THE SALVAGE PROBLEM

BUSINESS PRESS INDUSTRIAL SCRAP COMMITTEE
ROOM 3303, EMPIRE STATE BLDG., N. Y. C.

Please send scrap manual

Your name_____

Company name_____

Company address_____

To keep the wheels TURNING

BOWSER

LUBRICATING EQUIPMENT

Lubricating the wheels of industry has been a Bowser specialty for years. Whether you need a single feed lubricator or oiler for one bearing—a filter for an engine or turbine—an overflow sight or a pressure sight feed oiler—or even a huge system for a gigantic steel mill, you will find that it pays to consult Bowser. A staff of trained lubrication engineers is at your service . . . anytime.

FILTERS

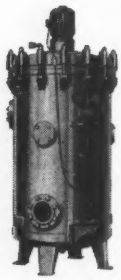
LUBRICATORS

OILERS

TURBINE OIL CONDITIONERS

SELF CONTAINED UNITS

COMPLETE SYSTEMS

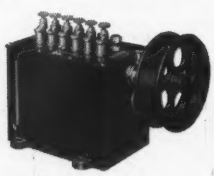


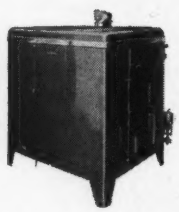
The self-cleaning filter (left) for lubricating oils and coolants has many special features. Various porosities and capacities are available.

The small self-cleaning filter for oils and coolants fills many needs.

Mechanical force-feed lubricators in various types from 1 to 28 feeds are available. Timed lubricators for Diesel cylinder lubrication may be had.

Turbine Oil Conditioners in various sizes for oils requiring acid correction — and to prevent build up of acid in new oil.





TO HELP WIN THE WAR OF Production

S. F. Bowser & Co., Inc.

Fort Wayne, Ind.

BOWSER

LUBRICATING OIL EQUIPMENT

METERING • DISPENSING • STORING

LUBRICATING • FILTERING • DISTILLING

Power Plant Construction News

Ala., Sheffield—Reynolds Alloys, Inc., subsidiary of Reynolds Metals Co., Federal Reserve Bank Bldg., Richmond, Va., plans installation of electric power equipment in new plant units for production of aluminum alloys, to be located in vicinity of present aluminum plant near Sheffield. Entire project will cost close to $2,900,000, with financing by Defense Plant Corp., Washington, D. C.

Calif., San Diego—Ryan Aeronautical Co., San Diego, manufacturer of airplanes and parts, plans installation of electric power equipment in new one-story addition, about 125 by 380 ft., to be used for sub-assembling service. Cost reported over $200,000. Frank L. Hope, Jr., San Diego Trust & Savings Bldg., is architect.

Del., Milton—Rockdale Creamery Corp., Milton, has plans under way for new five-story cold storage and food-freezing plant. Proposed to begin work soon. Cost reported over $60,000, with equipment.

D. C., Washington—Board of District Commissioners, District Building, has plans for extensions and improvements in Dalecarlia pumping station of municipal waterworks system, including installation of new motor-driven pumping units and auxiliary equipment. Cost estimated about $918,000, with machinery. Fund in that amount has been secured through Federal aid.

Idaho, Mountain Home—War Department, Washington, D. C., has authorized new air force base in vicinity of Mountain Home, comprising hangars, shops, warehouses and other industrial structures. Electric power equipment will be installed. A boiler house is planned, with power substation and electrical distribution lines. Entire project will cost over $5,000,000 and will be carried out under supervision of U. S. District Engineer Office, Portland, Ore.

Ill., Chicago—Commonwealth Edison Co., 72 West Adams St., has approved plans for extensions and improvements in Calumet steam-electric generating station, East 100th St., and will carry out work at once. Cost about $75,000, exclusive of equipment.

Ind., Fort Wayne—Magnovox Corp., Buetter Rd., manufacturer of radio loud speakers and other radio apparatus, plans installation of electric power equipment in new one-story addition, about 50 by 200 ft. Cost reported close to $100,000. Work is scheduled to begin at once.

Ind., Indianapolis—Glidden Co. Berea and Madison Aves., Cleveland, Ohio, manufacturer of paints, varnishes, oils, etc., plans installation of electric power equipment in new soy bean processing mill at Indianapolis, where company has acquired plant of Standard Cereals, Inc., Gent Ave., and will remodel and expand for this purpose. Cost reported over $250,000. Work will be carried out at once.

Ky., Bowling Green—Commodity Credit Corp., The Mall and Twelfth Sts., Washington, D. C., Federal agency, plans installation of electric power equipment in series of 11 new hemp-processing mills at different points in Kentucky, each reported to cost over $200,000. Proposed to carry out project in 1943. Different sites, now tentatively selected, include Bowling Green, Paris, Winchester, Owensboro, Henderson, Guthrie, Richmond, Brooksville, Nicholasville, Shelbyville and Danville. Financing will be provided by Defense Plant Corp., Washington, D. C.

Mass., Lawrence—Pacific Mills, Inc., has plans under way for converting of one of two power plants, used for service at textile mills, from oil to coal fuel, with installation of stokers, coal and ash-handling machinery, and accessory equipment. Work is scheduled to be carried out soon.

Mass., New Bedford—Cornell-Dubilier Electric Corp., Hamilton Boulevard, South Plainfield, N. J., manufacturer of capacitors, radio apparatus, etc., plans installation of electric power equipment in connection with expansion in branch plant at New Bedford, for production for Government. Entire project will cost over $250,000, with financing by Defense Plant Corp., Washington, D. C.

Mass., Salem—Salem Electric Lighting Co., 205 Washington St., has approved plans for new addition to local steam-electric generating station on Peabody St., about 32 by 42 ft., for expansion in steam department. No estimate of cost announced. Work will be placed under way at once. New England Power Service Co., 441 Stuart St., Boston, Mass., is consulting engineer.

Mich., Monroe—Consumers Power Co., Jackson, Mich., has acquired tract of about 500 acres of land in Erie Township, near Monroe, to be used as site for new steam-electric generating station in future. No time has as yet been determined when plant will be built.

Minn., St. Paul—Lake Mining Co., care of George C. Shallenberger, manager Great Northern Iron Ore Properties, First National Bank Building, St. Paul, recently organized by Mr. Shallenberger and associates, plans installation of electric power equipment in connection with development of tract of iron ore mining properties in Mesabi range, Northern Minnesota. A boiler house will be built. Entire project will cost about $5,500,000, of which $3,000,000 will represent an RFC loan. Work will begin soon.

N. J., Little Falls—Beattie Mfg. Co., Main St., manufacturer of carpets and rugs, has plans for new power house at mill, reported to cost over $65,000, with equipment. Proposed to carry out work at once. Gilbert Associates, Inc., 412 Washington St., Reading, Pa., is consulting engineer.

N. Y., Farmingdale—Liberty Aircraft Products Corp., Farmingdale, L. I., manufacturer of aircraft specialties, plans installation of electric power equipment in connection with expansion in plant for production for Government. Entire project will cost over $300,000, with financing by Defense Plant Corp., Washington, D. C.

Ohio, Cleveland—Addressograph-Multigraph Corp., 1200 Babbitt Rd., manufacturer of printing machines, addressing machinery, etc., plans installation of electric power equipment in connection with expansion in plant for production for Government. Cost estimated over $350,000, with financing provided by Defense Plant Corp., Washington, D. C. Work is scheduled to be carried out at once.

Ohio, Hamilton—Municipal Electric Plant, 214 South Second St., plans call for bids early in January for steam piping, electric wiring and other work in new addition to generating station, now under way. Entire project will cost about $230,000. Froehlich & Emery Engineering Co., Toledo Trust Bldg., Toledo, Ohio, is consulting engineer.

Pa., Philadelphia—F. C. Castelli & Co., 4055 Ridge St., manufacturer of tools, dies, gages, etc., plans installation of electric power equipment in new one-story addition, about 145 by 310 ft., for expansion in main machine division. Cost reported over $100,000, with machinery. Davis & Dunlap, 1717 Sansom St., are architects.

Pa., Philadelphia—Philadelphia Electric Co., 1000 Chestnut St., has filed plans for alterations and improvements in Richmond steam-electric generating station, Delaware Ave. and Lewis St., and will carry out work at once. No estimate of cost announced.

Tenn., Lewisburg—Marshall Stove Co., manufacturer of stoves and ranges, plans installation of electric power equipment in connection with expansion in plant for large increased output. Cost over $400,000, with financing provided by Defense Plant Corp., Washington, D. C. Work is scheduled to be carried out soon.

Tenn., Memphis—War Department, Washington, D. C., has authorized new air force base in vicinity of Memphis, with hangars, shops, warehouses and other industrial buildings. Electric power equipment will be installed, with power substation facilities and electrical distribution lines. Entire project will cost over $5,000,000 and will be carried out under supervision of U. S. District Engineer Office, Mobile, Ala.

Texas, Tyler—War Department, Washington, D. C., has approved plans for new air force base in vicinity of Tyler, including hangars, shops and other industrial buildings. Electric power equipment will be installed. A power substation is planned, with electrical distribution lines for light and power service. Entire project will cost close to $5,000,000, and will be supervised by U. S. District Engineer Office, Denison, Texas.

Wis., Chippewa Falls—State Department of Public Welfare, State Capitol, Madison, Wis., plans extensions and improvements in power house at Northern Wisconsin Colony and Training School, Chippewa Falls, including installation of new boiler units and auxiliary equipment. Proposed to arrange appropriation to carry out work in 1943. Roger C. Kirchhoff, State Capitol, Madison, is state architect.

Wis., Elkhorn—Elkhorn Locker Service, G. B. Church, head, plans new one and two-story L-shaped cold storage plant, 40 by 60 ft., and 22 by 64 ft., with locker system, to replace a structure recently destroyed by fire. Cost reported over $40,000, with equipment. John J. and Thomas H. Flad, 133 Langdon Street, Madison, Wis., are architects. Mr. Church, noted, is an official of Elkhorn Lumber Co., Elkhorn.

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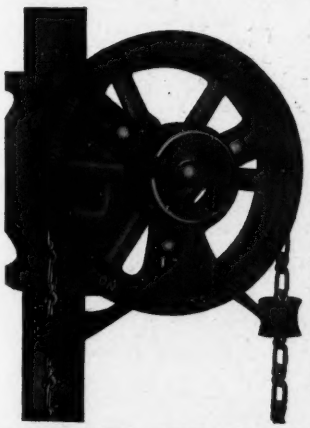
LADDER WORK



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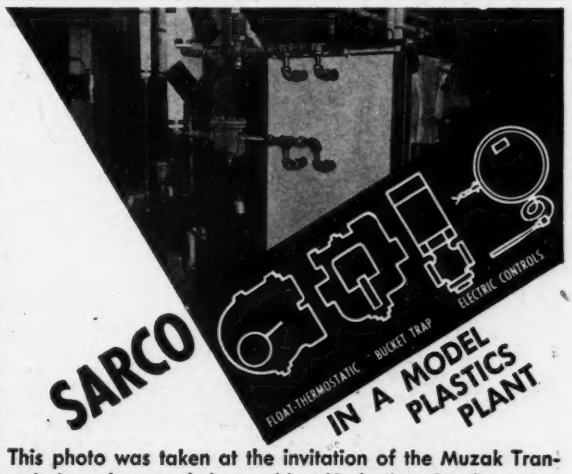

This photo was taken at the invitation of the Muzak Transcriptions, Inc., at their new New York plant for the manufacture of fine radio transcriptions of programs for broadcasting. Sarco selected float-thermostatic steam traps for the platens on the molding presses to secure continuous condensate removal without disturbing the temperature control; inverted bucket steam traps for the dryer coils and steam lines because they can stand hard knocks; Sarco thermotons for the cleaning and plating tanks because they combine temperature control at the cost of steam traps alone. Simple Sarco type LSS electric thermostats provide temperature control for the ovens.

155

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Fuller Company
Worthington Pump & Machy. Corp.

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Air Preheater Corp.
Babcock & Wilcox Company, The
Combustion Engrg. Co., Inc.
Foster Wheeler Corporation

AIR WASHERS
American Blower Corp.

ANTI-CORROSIVE COATINGS
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Haering & Co., Inc., D. W.

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Magnolia Metal Co.

ARCHES, BOILER & COMBUSTION
Carborundum Co., The

BAFFLES, BOILER
Engineer Co., The

BEARING METAL
Magnolia Metal Co.

BELTS, V TYPE
Gilmer Co., L. H.

BELTING, RUBBER
Gilmer & Co., L. H.

BELTING, SILENT CHAIN
Morse Chain Co.

BLOWERS, FAN AND FURNACE
American Coal Burner Co.
Coppus Engrg. Corp.
De Laval Steam Turbine Co.
Wing Mfg. Co., L. J.

BLOWERS, TURBINE
Elliott Company
Terry Steam Turbine Co., The
Wing Mfg. Co., L. J.

BOILER BLOW-DOWN SYSTEMS
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Elgin Softener Corp.
Henszey Company
Infilco Incorporated
National Aluminate Corp.
Permutit Co., The

BOILER COMPOUNDS
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Bird-Archer Co., The
Buromin Co., The
Dearborn Chemical Company
Dowell Incorporated
Electric Chemical Co.
Haering & Co., Inc., D. W.
Permutit Co., The
Water Treatment Co. of America

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Permutit Co., The

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Buromin Company, The
Cochrane Corp.
Dearborn Chemical Company
Dowell Incorporated
Electric Chemical Co.
Elgin Softener Corp.
Graver Tank & Mfg. Co., Inc.
Hall Laboratories, Inc.
Haering & Co., Inc., D. W.
Infilco Incorporated
National Aluminate Corp.
Permutit Co., The
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Wickes Boiler Co., The

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BUCKET ELEVATORS
Bartlett & Snow Co., The C. O.

BURNERS, COAL, PULVERIZED
Babcock & Wilcox Co., The

BURNERS, COMBINATION, OIL & GAS, OIL & COAL, GAS & COAL
Babcock & Wilcox Co., The

BURNERS, GAS
Engineer Co., The

BURNERS, OIL
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Engineer Co., The

BURNERS, WIDE RANGE OIL
Babcock & Wilcox Co., The

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CEMENT, IRON
Smooth-On Mfg. Company
X-pando Corp.

CEMENT, REFRACTORY, ACID PROOF, FURNACE AND HIGH TEMPERATURE
Atlas Lumnite Cement Co., The
Babcock & Wilcox Company, The
Baldwin-Hill Co.
Carborundum Co., Inc.
Ehret Magnesia Mfg. Co.
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CHAINS, DRIVE
Morse Chain Co.

CHAIN WHEELS
Babbitt Steam Specialty Co.

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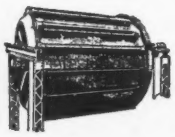
Betz, W. H. & L. D.
Bird-Archer Co., The
Buromin Company, The
Dearborn Chemical Company
Dowell Incorporated
Electric Chemical Co.
Elgin Softener Corp.
Haering & Co., Inc., D. W.
National Aluminate Corp.
Permutit Co., The
% Proportioneers %, Inc.
Water Treatment Co. of America

CHIMNEYS
American Chimney Corp.

"PENNSYLVANIA" CRUSHERS



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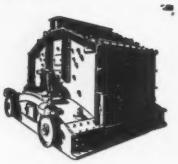

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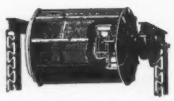

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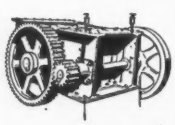

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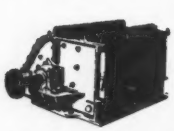

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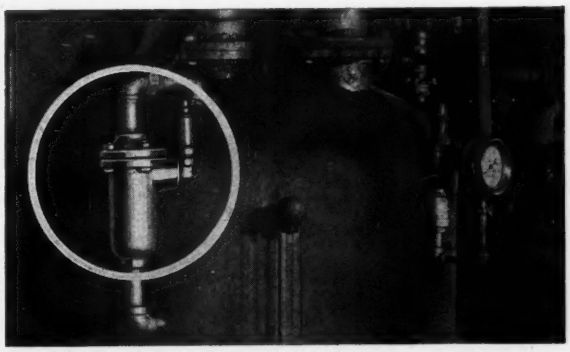

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Water Treatment Co. of America

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FILTERS, WATER
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FITTINGS, MALLEABLE
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GAUGE COCKS
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GAUGES, DRAFT, LIQUID LEVEL
Bailey Meter Company
Brown Instrument Co., The
Hays Corporation, The
Liquidometer Corp.
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GAUGES, PRESSURE AND RECORDING
Bacharach Ind. Inst. Co.

GAUGES, TANK
Liquidometer Corp.

GAUGES, WATER
Ernst Water Column & Gage Co.
Huyette Co., Inc., The Paul B.
Lunkenheimer Co., The
Reliance Gauge Column Co.
Williams Gauge Co., The
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De Laval Steam Turbine Co.
Terry Steam Turbine Co., The

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Allis-Chalmers Mfg. Co.
Elliott Company
Murray Iron Works Co.
Terry Steam Turbine Co., The
Troy Engine & Machine Co.

GENERATORS, ELECTRIC
Allis-Chalmers Mfg. Co.
Elliott Company
General Electric Company
Murray Iron Works Co.
Terry Steam Turbine Co., The
Troy Engine & Machine Co.

GOVERNORS, PUMP
Atlas Valve Company
Cash Company, A. W.
Davis Regulator Co.
Fisher Governor Co.
Foster Engrg. Co.
Northern Equipment Company
Williams Gauge Co., The

GRATES & GRATE BARS
Flynn & Emrich Co.
Squires Co., The C. E.
Swartwout Co., The

GRATING, STEEL
Dravo Corporation

Use VULCODISC

for trouble-free valve jobs

In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.

Dense without being brittle—tough, yet resilient, Vulcodisc will not swell, warp or soften—in fact its absorption is less than 1 per cent. . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder.

Write for descriptive bulletin.

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Cincinnati, Ohio

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For Your Convenience

Everything from Air Compressors to Whistles — 266 different classes of products used in operating and maintaining power plants—are listed each month in the Where-To-Buy section of this magazine.

Make it a rule to turn first to this up-to-date directory when you're in the market for power service equipment and supplies. It's classified for your convenience, can save you time and money.

Equipment and Supplies Advertised Regularly in POWER PLANT ENGINEERING

GREASE, LUBRICATING
Cook's Sons, Inc., Adam
Cities Service Oil Co.
Shell Oil Co., Inc.
Socony-Vacuum Oil Co., Inc.
Standard Oil Co. (Indiana)
Sun Oil Company
Texas Company, The
Tide Water Associated Oil Co.

HEATERS, AIR
Prat-Daniel Corp.

HEATERS, WATER
American District Steam Co.
Lummus Co., The
Permutit Co., The

HEAT EXCHANGERS
Babcock & Wilcox Co., The
Kellogg Co., The M. W.
Lummus Co., The
Marley Company, The
Vogt Machine Co., Inc., Henry

HOISTS
American Eng'r'g Co.

HYDROMETERS
Taylor Instrument Cos.

ICE MAKING AND REFRIGERATING MACHINERY
Vogt Machine Co., Inc., Henry
Worthington Pump & Machy. Corp.

ILLUMINATORS, GAUGE GLASS
Ernst Water Column & Gage Co.

INSTRUMENTS, ELECTRICAL
Biddle Co., Jas. G.
General Electric Company
Leeds & Northrup Co.

INSULATION, HEAT
American Dist. Steam Co.
Baldwin-Hill Co.
Ehret Magnesia Mfg. Co.
Johns-Manville

INSULATION TESTERS
Biddle Co., Jas. G.

INSULATING MATERIAL
General Electric Company

JOINTS, EXPANSION
American District Steam Co.
Yarnall-Waring Company

LUBRICANTS
Cities Service Oil Co.
Cook's Sons, Inc., Adam
Shell Oil Co., Inc.
Socony-Vacuum Oil Co., Inc.
Standard Oil Co. (Indiana)
Sun Oil Company
Texas Company, The
Tide Water Associated Oil Co.

LUBRICATING PASTE
Garlock Packing Co., The

LUBRICATORS
Bowser & Co., Inc., S. F.
Lunkenheimer Co., The
Manzel Brothers Company
Powell Co., The Wm.
Williams Valve Co., The D. T.

MAGNETIC SEPARATORS
Cutler-Hammer, Inc.

MECHANICAL DRAFT APPARATUS
American Blower Corp.
Coppus Engrg. Corp.

METAL ENCLOSED CUBICLE CONTROL
Cutler-Hammer, Inc.

METAL HOSE
Bendix Aviation Corp.

METERS, AIR AND GAS
American Dist. Steam Co.
Bailey Meter Company
Builders-Providence, Inc.
Cochrane Corp.
Republic Flow Meters Co.

METERS, BOILER
Bailey Meter Company
Brown Inst. Co., The
Builders-Providence, Inc.
Hays Corporation, The
Republic Flow Meters Co.
Taylor Instrument Cos.

METERS, COAL
Bailey Meter Company

METERS, WATER AND STEAM
American District Steam Co.
Bailey Meter Company
Brown Inst. Co., The
Builders-Providence, Inc.
Infilco Incorporated
Cochrane Corporation
Henszey Company
Republic Flow Meters Co.
Simplex Valve & Meter Co.
Taylor Instrument Cos.

MONEL METAL RINGS, RODS, CASTINGS, FORGINGS, TUBING, SHEETS, WIRE AND WIRE CLOTH
International Nickel Co., Inc.

MOTOR CONTROL
Cutler-Hammer, Inc.

MOTORS
Allis-Chalmers Mfg. Co.
Elliott Company
General Electric Company

MUFFLERS
Burgess Battery Co.

NOZZLES FOR ALL PURPOSES
Bacharach Ind. Inst. Co.
Marley Company, The
Yarnall-Waring Company

NOZZLES, BOILER
Taylor Forge & Pipe Wks.

OIL AND GREASE CUPS
Lunkenheimer Co., The
Powell Co., The Wm.
Williams Valve Co., The D. T.

OIL BURNING EQUIPMENT
Engineer Co., The

OILERS, TELESCOPIC
Nugent & Co., Inc., Wm. W.

OILING AND FILTERING SYSTEMS
Bowser & Co., Inc., S. F.
Nugent & Co., Inc., Wm. W.

OILING DEVICES
Bowser & Co., Inc., S. F.
Nugent & Co., Inc., Wm. W.

OILS, CUTTING
Cities Service Oil Co.
Shell Oil Co., Inc.
Socony-Vacuum Oil Co., Inc.
Standard Oil Co. (Indiana)
Sun Oil Company
Texas Company, The
Tide Water Associated Oil Co.

OILS, FUEL
Cities Service Oil Co.
Shell Oil Co., Inc.
Socony-Vacuum Oil Co., Inc.
Standard Oil Co. (Indiana)
Sun Oil Company
Texas Company, The
Tide Water Associated Oil Co.

OILS, LUBRICATING
Cities Service Oil Co.
Cook's Sons, Inc., Adam
Shell Oil Co., Inc.
Socony-Vacuum Oil Co., Inc.
Standard Oil Company (Indiana)
Sun Oil Company
Texas Company, The
Tide Water Associated Oil Co.

OIL PUMPING AND HEATING EQUIPMENT
Engineer Co., The

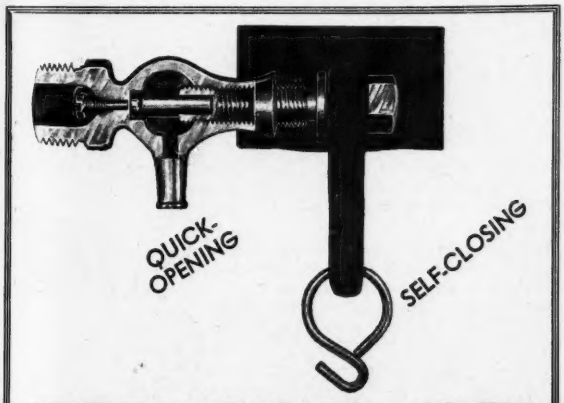
OIL STORAGE EQUIPMENT
Bowser & Co., Inc., S. F.

OIL TANKS
Bowser & Co., Inc., S. F.
Graver Tank & Mfg. Co., Inc.
Manzel Brothers Company

ORSATS
Bacharach Ind. Inst. Co.

PACKING, ASBESTOS, FLAX AND METALLIC
Belmont Pkg. & Rubber Co., The
Chesterton Co., A. W.
Ehret Magnesia Mfg. Co.
France Packing Co.
Garlock Packing Co., The
Johns-Manville
Raybestos-Manhattan, Inc.

PACKING, METALLIC, FOR CONDENSER TUBES
Belmont Pkg. & Rubber Co., The
France Packing Co.
Garlock Packing Co., The
Raybestos-Manhattan, Inc.



"PBH" GAUGE COCK

A gentle pull opens this sturdy, long-wearing gauge cock and an adjustable weight automatically closes it when you let go. Removable monel metal seat and copper valve pencil insures leak-tight service.

Write today for catalogue and prices.

The PAUL B. HUYETTE CO., Inc.
Est. 1896
401 N. BROAD ST. PHILADELPHIA, PA.

WATER GAUGES—*Vertical and Inclined*
GAUGE-GLASS PROTECTORS • AIRTITE
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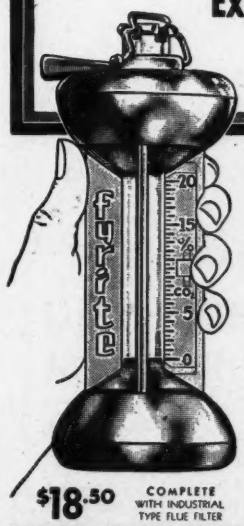
BOILER ALARMS, INSTRUMENTS & CONTROLS

FUEL is Vital for VICTORY

FYRITE CO_2 Readings Expose Fuel Waste *INSTANTLY!*



The amazingly simplified FYRITE "Orsat" Analyzer makes accurate flue gas tests easy—instantly telling you what percentage of your fuel is being wasted. The FYRITE is conveniently held in the hand while analysis is taken. It is accurate within ½ of 1% CO_2; spill-proof in any position; rugged, durable, compact. More than 7000 in use.

RETURN COUPON BELOW. *Obtain literature on Fyrite and learn how to get immediate delivery under priority regulations.*

$18.50 COMPLETE WITH INDUSTRIAL TYPE FLUE FILTER

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Address _____

City _____ State _____ P P

A Convenient Listing of Power Plant

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Chesterton Co., A. W.
Combination Pump Valve Co.
Ehret Magnesia Mfg. Co.
France Packing Co.
Garlock Packing Co., The
Johns-Manville
Raybestos-Manhattan, Inc.

PACKING, SHEET, VALVE, PUMP
Belmont Pkg. & Rubber Co., The
Chesterton Co., A. W.
Ehret Magnesia Mfg. Co.
France Packing Co.
Garlock Packing Co., The
Johns-Manville
Raybestos-Manhattan, Inc.

PAINT, ANTI-CORROSIVE, METAL, PROTECTIVE, STEEL PRESERVATIVE, HEAT RESISTING
Dampney Co. of Amer.

PANEL BOARDS
Falstrom Company

PHOSPHATE CONTROL EQUIPMENT
Betz, W. H. & L. D.
Taylor & Co., W. A.

pH CONTROL EQUIPMENT
Betz, W. H. & L. D.
Permutit Co., The
Taylor & Co., W. A.

PIPE BENDING
Flori Pipe Co., The
Watson-Stillman Co., The

PIPE COILS AND BENDS
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Flori Pipe Co., The
Grinnell Company, Inc.
Kellogg Co., The M. W.
Midwest Piping & Supply Co.
National Valve & Mfg. Co.
Rempe Company
Scovill Mfg. Co.
Taylor Forge & Pipe Wks.
Vogt Machine Co., Inc., Henry

PIPE COVERING
American District Steam Co.
Baldwin-Hill Co.
Ehret Magnesia Mfg. Co.
Johns-Manville
Porter Co., H. W.

PIPE, FLANGE
Flori Pipe Co., The

PIPE, IRRIGATION
Flori Pipe Co., The

PIPE SAVERS
Sarco Company, Inc.

PIPE, SEAMLESS STEEL
Flori Pipe Co., The

PIPE, SPIRAL WELDED
Taylor Forge & Pipe Wks.

PIPE SUPPORTS, GUIDES
American District Steam Co.
Grinnell Company, Inc.

PIPING MANUFACTURERS, FABRICATORS
Electroweld Steel Corp.
Flori Pipe Co., The
Grinnell Company, Inc.
Kellogg Co., The M. W.
Midwest Piping & Supply Co.
National Valve & Mfg. Co.
Steel & Tubes Division of Republic Steel Corp.
Taylor Forge & Pipe Wks.

POWER METAL
Magnolia Metal Co.

POWER TRANSMISSION EQUIPMENT
Gilmer Co., L. H.
Morse Chain Co.
Worthington Pump & Machy. Corp.

PROPORTIONING MACHINES
Haering & Co., Inc., D. W.
% Proportioneers %, Inc.
Taylor & Co., W. A.

PROTECTIVE COATING
Dampney Co. of Amer.

PULVERIZED FUEL EQUIPMENT
Combustion Engrg. Co., Inc.
Foster Wheeler Corporation

PULVERIZERS
American Pulverizer Co.
Babcock & Wilcox Co., The
Bartlett & Snow Co., The C. O.
Pennsylvania Crusher Co.

PUMP PRIMING SYSTEMS
De Laval Steam Turbine Co.

PUMPS, BARREL
Blackmer Pump Co.

PUMPS, BOILER FEED
Aldrich Pump Co.
Allis-Chalmers Mfg. Co.
Coppus Engrg. Corp.
De Laval Steam Turbine Co.
Warren Steam Pump Co., Inc.
Worthington Pump & Machy. Corp.

PUMPS, CENTRIFUGAL
Aldrich Pump Co.
Allis-Chalmers Mfg. Co.
Coppus Engrg. Corp.
De Laval Steam Turbine Co.
Pomona Pump Co.
Warren Steam Pump Co., Inc.
Worthington Pump & Machy. Corp.

PUMPS, DEEP WELL
Aldrich Pump Co.
Pomona Pump Co.

PUMPS, ELEVATOR, FIRE AND GENERAL SERVICE
De Laval Steam Turbine Co.
Warren Steam Pump Co., Inc.

PUMPS, HYDRAULIC PRESSURE
Aldrich Pump Co.
Blackmer Pump Co.
Warren Steam Pump Co., Inc.

PUMPS, OIL
Bowser & Co., Inc., S. F.
Blackmer Pump Co.
De Laval Steam Turbine Co.
Engineer Co., The
Manzel Brothers Company

PUMPS, PORTABLE POWER
Blackmer Pump Co.

PUMPS, POWER, ELECTRIC
Aldrich Pump Co.
Blackmer Pump Co.
Warren Steam Pump Co., Inc.
Worthington Pump & Machy Corp.

PUMPS, RECIPROCATING
Watson-Stillman Co., The

PUMPS, ROTARY
Blackmer Pump Co.

PUMPS, STEAM JACKETED
Blackmer Pump Co.

PUMPS, TURBINE
Warren Steam Pump Co., Inc.

PUMPS, VACUUM
Fuller Company
Warren Steam Pump Co., Inc.

PUMPS, WATERWORKS
Pomona Pump Co.
Warren Steam Pump Co., Inc.

PURGERS
Armstrong Machine Wks.

PURIFIERS, BOILER FEED
Cochrane Corp.
Elgin Softener Corp.
Graver Tank & Mfg. Co., Inc.
Infilco Incorporated
Permutit Co., The

..MAY HELP YOU IN YOUR PROBLEM

True, most of our work at present is in War-Time activities. But there are no priorities on thinking and planning for peace. Water Refining Headquarters will be glad to answer your problems . . . and perhaps we can furnish some equipment now.

1. *Zeolite Water Softening*
2. *Corrective Chemical Feeders*
3. *Hot Process Water Softening*

THE AMERICAN WATER SOFTENER COMPANY
324 LEHIGH AVE., PHILADELPHIA, PA.

MANZEL FEEDERS ELIMINATE GUESS WORK IN TREATING BOILER WATER

Boiler compound injected in accurately measured amounts by Manzel Chemical Feeders insures maximum protection for your boilers. Installed directly on the feed water pump, Manzel Feeders inject a pre-determined amount of chemical on each pump stroke.

Every gallon of water is treated because Manzels start, stop, speed up and slow down with the pump.

The pumping unit is the only part that comes in contact with the chemical. The entire feeder is sturdily built for years of trouble-free service.

Write for bulletin.

MANZEL BROS. COMPANY
327 Babcock St. Buffalo, N. Y.

Squires

Boiler Feed Water Controllers maintain a constant water lever in your boilers, feeding them in proportion to evaporation.

Let us send you Circular E-12

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E. 40th St. and Kelley Ave.
Cleveland, Ohio

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Nugent & Co., Inc., Wm. W.

PURIFIERS, STEAM
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Cochrane Corp.
Hagan Corporation
Infilco Incorporated
Marley Company, The

PYROMETERS
Bailey Meter Co.
Brown Instrument Co., The
Leeds & Northrup Co.

RECORDING INSTRUMENTS
American Dist. Steam Co.
Bacharach Ind. Inst. Co.
Builders-Providence, Inc.
Cochrane Corp.
Leeds & Northrup Co.
Sarco Company, The
Simplex Valve & Meter Co.
Taylor Instrument Cos.

REFRACTORIES
Atlas Lumnite Cement Co., The
Babcock & Wilcox Co., The
Carborundum Co., The

REFRACTORY PATCHING MATERIAL
Atlas Lumnite Cement Co., The
Babcock & Wilcox Co., The
Kellogg Co., The M. W.

REGULATORS, DAMPER
American Coal Burner Co.
Atlas Valve Company
Cash Company, A. W.
Hagan Corporation
Hays Corporation, The
Republic Flow Meters Co.

REGULATORS, FAN ENGINE
Atlas Valve Company
Foster Engrg. Co.

REGULATORS, FEED WATER
Atlas Valve Company
Bailey Meter Company
Northern Equipment Company
Republic Flow Meters Co.
Squires Company, The C. E.
Swartwout Co., The
Williams Gauge Co., The

REGULATORS, PRESSURE
Atlas Valve Company
Cash Company, A. W.
Davis Regulator Co.
Fisher Governor Co.
Foster Engrg. Co.
Hagan Corporation
Northern Equipment Company
Republic Flow Meters Co.
Sarco Company, Inc.
Squires Company, The C. E.
Strong, Carlisle & Hammond Co.
Swartwout Co., The

REGULATORS TEMPERATURE
Atlas Valve Company
Foster Engrg. Co.
Sarco Company, Inc.

REPAIR AND RESURFACING MATERIAL
Flexrock Company
Smooth-On Mfg. Co.
X-pando Corp.

RESEATING MACHINES, VALVE
Leavitt Machine Co., The

RESISTANCES
Cutler-Hammer, Inc.

RHEOSTATS
Cutler-Hammer, Inc.

RINGS, CHILL
Wedge Protectors, Inc.

RUST PREVENTIVES
Dearborn Chemical Company
Dowell, Incorporated
Haering & Co., Inc., D. W.
Water Treatment Co. of America

SCALE REMOVERS, MECHANICAL
Airetool Mfg. Co.
Elliott Company
Roto Company, The
Wilson, Inc., Thos. C.

SCALE REMOVING COMPOUNDS
American Water Softener Co., The
Bird-Archer Co., The
Buromin Co., The
Dearborn Chemical Company
Dowell, Incorporated
Electric Chemical Co.
Haering & Co., Inc., D. W.
Permutit Co., The
Water Treatment Co. of America

SCRAPERS, DRAGLINE
Sauerman Bros., Inc.

SCALES, COAL
Richardson Scale Co.

SEPARATORS AND EXTRACTORS
Cochrane Corporation
Elliott Company
Hagan Corporation
Marley Compay, The
National Valve & Mfg. Co.
Nicholson & Co., W. H.
Strong, Carlisle & Hammond Co.
Swartwout Co., The
Williams Valve Co., The D. T.

SEPARATORS, COMP. AIR
Leavitt Machine Co., The

SHAFTING
Electroweld Steel Corp.
Steel & Tubes Division of Republic Steel Corp.

SIGHT FLOW INDICATORS
Cochrane Corp.

SILENCERS
Burgess Battery Co.

SODIUM ALUMINATE
Dearborn Chemical Company
National Aluminate Corporation

SPEED INDICATORS
Biddle Co., Jas. G.

SPEED REDUCERS, CHAIN
Morse Chain Co.

SPRAY COOLING EQUIPMENT
Marley Company, The
Pritchard & Co., J. F.
Yarnall-Waring Company

SPRINKLERS
Grinnell Company, Inc.

SPROCKET RIMS
Babbitt Steam Specialty Co.

SPROCKETS
Morse Chain Co.

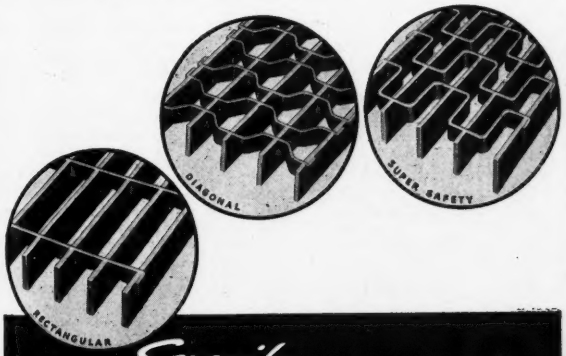
STACKS
Prat-Daniel Corp.

STEAM TRAPS
American District Steam Co.
Anderson Co., The V. D.
Armstrong Machine Works
Cochrane Corporation
Crane Co.
Davis Regulator Co.
Fisher Governor Co.
Golden-Anderson Valve Specialty Co.
Nicholson & Co., W. H.
Sarco Company, Inc.
Squires Co., The C. E.
Strong, Carlisle & Hammond Co.
Swartwout Co., The
Williams Gauge Co., The
Williams Valve Co., The D. T.
Yarnall-Waring Company

STOKERS, MECHANICAL OVERFEED AND GRATE
American Coal Burner Co.
American Engrg. Company
Babcock & Wilcox Co., The
Combustion Engrg. Co., Inc.
Detroit Stoker Company
Flynn & Emrich Co.
Iron Fireman Mfg. Co.

STOKERS, UNDERFEED
American Engrg. Company
Combustion Engrg. Co., Inc.
Canton Stoker Corp.
Detroit Stoker Company
Flynn & Emrich Co.
Iron Fireman Mfg. Co.

STRAINERS
Blackmer Pump Co.
Cash Company, A. W.
Davis Regulator Co.
Edward Valve & Mfg. Co., Inc., The
Elliott Company
Fisher Governor Co.
Nicholson & Co., W. H.
Nugent & Co., Inc., Wm. W.
Sarco Company, Inc.
Strong, Carlisle & Hammond Co.
Yarnall-Waring Co.



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OPEN STEEL FLOORING • SAFETY STEPS
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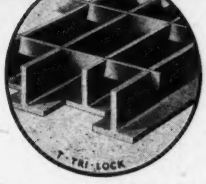
Full descriptive catalog of Tri-lok Grating, Safety Treads and other products on request.



ASK for our special folder about THIS
Feed Water Regulator

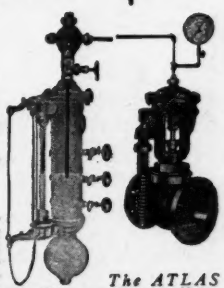
The folder gives 17 Reasons why the
CAMPBELL
is preferred by boiler operating engineers.

Here are eleven of the reasons: 1—Continuous Blowdown; 2—No Moving Parts; 3—No Thermostats; 4—No Floats; 5—No Links; 6—No Generators; 7—Instantaneous Response; 8—Utmost Simplicity; 9—Lifelong Dependability; 10—High Efficiency and 11—Maximum Economy.

We can't give all of the advantages here. For instance its quick response to water level changes makes it ideal for handling abrupt load jumps.

Again, where desired, the water level can be varied through a range of 5" or 6" before fully opening or closing the feed water control valve. In other words the CAMPBELL can be made to handle your own boiler conditions most effectively.

We make regulating valves for every service. See partial list at the right. Check and mail with your name, firm name, and address.



The Regulator and Sampling Pipe

The ATLAS Control Valve, above, is easily piped to the Regulator

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE
291 South St., Newark, N. J.
Representatives in Principal Cities

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☐ Damper Regulators
☐ Temperature Regulators
☐ Reducing Valves
☐ Exhaust Control Systems
☐ Pressure Regulators
☐ Pump Governors
☐ Float Valves
☐ Oil Control Cocks
☐ Humidity Controllers
☐ Thermostats
☐ Balanced Valves
☐ Control Valves

A Convenient Listing of Power Plant

WHERE TO BUY DIRECTORY

SUPERHEATERS, STEAM
Babcock & Wilcox Co., The
Combustion Engrg. Co., Inc.
Foster Wheeler Corporation
Marley Company, The

SWITCHBOARDS
General Electric Company

SWITCHES, SAFETY
Cutler-Hammer, Inc.

TACHOMETERS
Biddle Co., James G.
Brown Instrument Co., The

TANKS
Graver Tank & Mfg. Co., Inc.
Kellogg Co., The M. W.

THERMOMETERS, DIAL
Sarco Company, Inc.

THERMOMETERS, INDICATING & RECORDING
Brown Inst. Co., The
Leeds & Northrup Co.
Taylor Instrument Cos.

TILE CONDUIT FOR STEAM LINES
American District Steam Co.
Porter Co., H. W.
Ric-Wil Co., The

TRAPS, COMPRESSED AIR, VACUUM
American Blower Corp.
Anderson Co., The V. D.
Armstrong Machine Works
Nicholson & Co., W. H.
Sarco Company, Inc.
Strong, Carlisle & Hammond Co.

TRAPS, STEAM, RADIATOR AND RETURN
American District Steam Co.
Anderson Co., The V. D.
Armstrong Machine Works
Nicholson & Co., W. H.
Sarco Company, Inc.
Strong, Carlisle & Hammond Co., The
Yarnall-Waring Company

TUBE CLEANERS, BOILER AND CONDENSER
Airetool Mfg. Co.
Chesterton Co., A. W.
Elliott Company
Roto Company, The
Wilson, Inc., Thos. C.

TUBES, SEAMLESS STEEL
Babcock & Wilcox Tube Co., The
Electroweld Steel Corp.
Steel & Tubes Division of Republic Steel Corp.

TUBING
Electroweld Steel Corp.
Flori Pipe Co., The
Scovill Mfg. Co.
Steel & Tubes Division of Republic Steel Corp.

TURBINES, STEAM
Allis-Chalmers Mfg. Co.
De Laval Steam Turbine Co.
Elliott Company
General Electric Company
Murray Iron Works Co.
Terry Steam Turbine Co., The
Wing Mfg. Co., L. J.

TRY COCKS
Ernst Water Column & Gage Co.

UNDERGROUND HEATING SYSTEMS
American District Steam Co.
Baldwin-Hill Co.
Ehret Magnesia Mfg. Co.
Johns-Manville
Porter Co., H. W.,
Ric-Wil Company, The

UNIONS
Crane Co.
Dart Mfg. Co., E. M.
Edward Valve & Mfg. Co., Inc., The

UNIT HEATERS
American Blower Corp.
Cutler-Hammer, Inc.
Grinnell Co., Inc.
Murray Iron Wks. Co.
Wing Mfg. Co., L. J.

VALVE DISCS
Combination Pump Valve Co.
Fairbanks Company, The
Garlock Packing Company

VALVES, ACID
Everlasting Valve Co.

VALVES, AIR OPERATED
Everlasting Valve Co.
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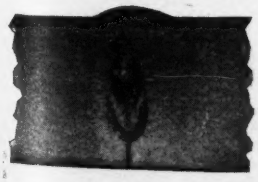

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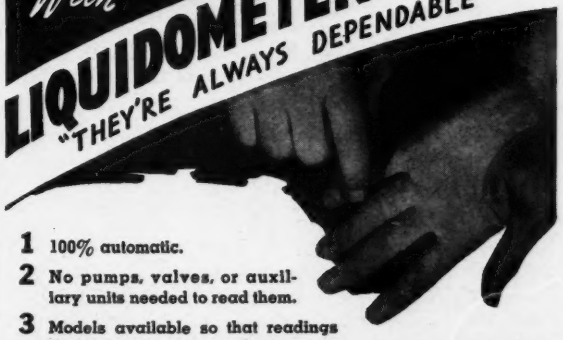

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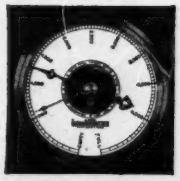

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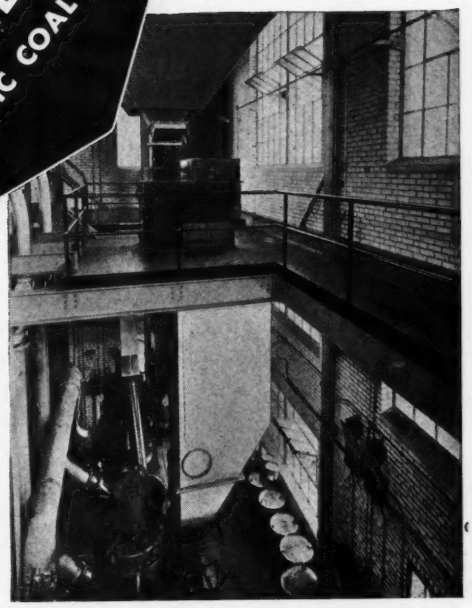

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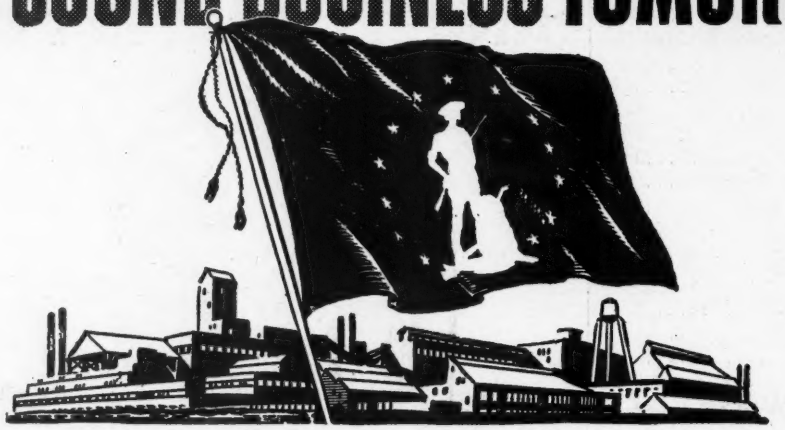

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and the PLUG of Chapman's List 960 has EXTRA PROTECTION, too . . .

ARMY NAVY

THE CHAPMAN VALVE MANUFACTURING CO.
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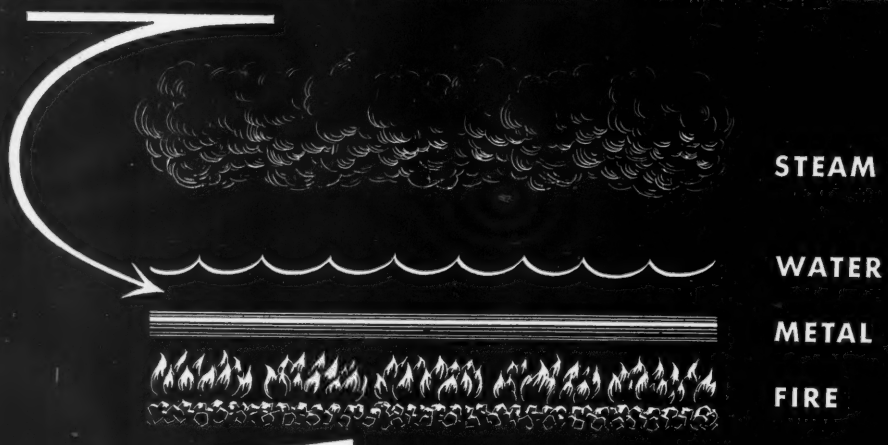
Forcing your boilers? Be sure heat-transfer surfaces are clean!



THE heat-transfer surface—that's where fuel is wasted by "misplaced insulation" caused by improperly treated feedwater. That's where metal is overheated, where it weakens, fails and causes boiler shutdowns.

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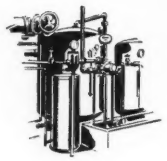
PERMUTIT

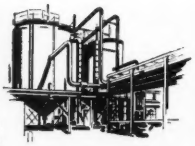
WATER CONDITIONING HEADQUARTERS

ZEO-KARB* H



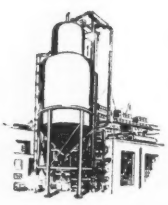
The new Permutit Zeo-Karb H water softener removes both hardness and bicarbonates from the raw water. The effluent is soft and reduced in total solids and alkalinity. The sulphate-carbonate ratio may be adjusted as desired by blending.

HOT LIME SODA



Lime and soda ash in correct proportions, precipitate the bulk of the hardness as calcium carbonate and magnesium hydroxide. The sludge that is formed is settled out in the settling tank after which the water is filtered. Integral deaerator simultaneously removes the oxygen.

DEAERATING HEATER



The new Permutit Deaerating Heater, utilizing exhaust or bled steam, is guaranteed to remove all oxygen and free CO_2. It is designed for pressures up to 100 pounds or higher. Capacities from 12,500 to 1,400,000 pounds per hour are in service.

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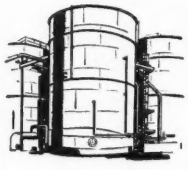

Permutit's new process is adaptable to Hot or Cold Lime Soda treatment, and can be applied to existing equipment. It reduces silica content to any degree desired . . . eliminates scale and deposits. The reagents used are low in cost and do not add soluble by-products.